TECHNOLOGY TRANSFER IN INTERNATIONAL JOINT VENTURE PROJECTS IN CHINA

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Abstract

Following the establishment of a theoretical framework for analysing the technology transfer process between construction industries in different countries, this thesis presents findings from an investigation of international joint venture projects in the People's Republic of China. The main study was based on a structured survey which was carried out in Xinjiang, Henan and Jiangsu provinces after a pilot study had been completed on the huge Sino-foreign joint venture demonstration project at Xiaolangdi in Henan province. Both studies adopted a cross-cultural approach to investigation. An assessment inventory was designed for data collection on the pilot study. This proved to be useful technique and was modified for the main study. The findings suggested important implications for the relationship between technology transfer and economic development. Technology transfer is not obtainable if there is too big a gap in terms of economic development between transfer and transferee. The contribution of the study has been to confirm that technology transfer cannot properly take place without knowledge transfer. Moreover, knowledge transfer itself has a number of components, of which it is argued that explicit knowledge and tacit knowledge transfer are the most significant. There are a number of mechanisms already in place for explicit knowledge transfer and this research used the term *method statement* as a means of investigating their effectiveness. It was concluded that such systems are generally being used to good effect. Nevertheless, tacit knowledge transfer is considerably more haphazard and it is in this area that knowledge transfer can falter and technology transfer can be impeded. This study suggests means by which tacit knowledge transfer could be improved. The outcomes will enable policy-makers within government, sponsors of projects and executives of companies involved to address the existing deficiencies and develop more appropriate arrangements for the transfer of tacit and explicit knowledge. In addition, it also leads the way for the introduction of systematic processes that could be specifically incorporated into World Bank projects that involve international technology transfer as a major feature.

Acknowledgements

It is clear that the process of conducting and completing a PhD research project is rewarding but difficult to achieve. The freshness and enthusiasm at the beginning of the process soon disappears as time passes by and considerable work and sustained effort is devoted. During this long process, sometimes the researcher is encouraged, however, most of the times the researcher faces a cross-road ahead and loses his direction. It is the supervisors who guide the researcher and make the research project go. Therefore, the author would like to acknowledge the considerable work and great contribution made by his supervision team. Through the many years that it has taken to produce this thesis the author's Director of Studies, Dr Bob Giddings and Supervisor, Dr David Greenwood have given continuous support and guidance. Indeed, it is a testimony to the value of their supervision and their belief and philosophy in the quality of the developing work that a thesis has been completed.

In the mean time, the author would like to record his thanks to The International Co-operation Section, Ministry of Construction, PRC, The Foreign Affairs Department, Yellow River Water & Hydropower Development Corporation (client of Xiaolangdi Project), The Construction Management Bureau of Jiangsu Province, Henan Province and Xinjiang Autonomous Region, PRC. Without their support and assistance in arranging interviews and conducting survey, it would have been impossible to produce the thesis. Finally, the author must acknowledge the informal support given by members of staff in the School of Built Environment, International Office and Newcastle Business School of the University of Northumbria. Their contributions helped to make the years of time spent in completing this research project both memorable and enjoyable.

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Chapter One

Introduction

1.1. Background to the Research

Technology transfer is recognised as the acquisition, adaptation and use of technological knowledge by an individual, group, or society other than the one that developed the technology. The concept of technology transfer involves more than the capacity to acquire new knowledge, or produce improved production processes (Miles, 1995). It also encompasses the capacities to link engineering and managerial skills to plan, develop and implement technological capacities to shape and accomplish the strategic and operational objectives of the host organisation.

Technology transfer has been a subject of considerable interest to many groups, such as government policymakers, international funding agencies, and business executives, because of the close relationship between technology transfer and economic growth. Technology transfer has aroused the interest of academic researchers. Despite all this attention, however, the concept of technology transfer and mechanisms of technology transfer remains vague, controversial, and inadequately operationalised (Samli,1985).

Technology transfer is shrouded not only in controversy and emotion, but also in considerable confusion, owing to the complexity of "technology" itself and the multiplicity of channels of its "transfer". A difficulty lies in determining what to evaluate, since technology transfer has two main dimensions: that from the seller/transferor to the buyer/transferee, and that relating to the effective diffusion and application of the technology (Erdilek and Rapoport, 1985).

1.2. Research Problems

The literature review provides a wide and extensive understanding of international technology transfer, e.g. definition, history, processes and channel of technology transfer, and problems of measuring technology transfer. In particular, a long involvement of technology transfer in construction is revealed by the literature review. With a few exceptions that touch international technology transfer (Abbott, 1985; Carrillo, 1993; Bon, 1997; and Ofori, 2000), little has been done in the research

area of knowledge transfer, in particular, tacit knowledge transfer. However, it has been clear that the subsequent literature review (Tsang, 1995, *et al.*; Maitland, 1999; Holland, 1999; and Egbu, 2000, *et al.*) of knowledge transfer in terms of explicit knowledge and tacit knowledge has made the research aims more focused. Hence, the research problems addressed in this study, are:

- *Is technology transfer appropriately and effectively channelled?*
- *What is the relationship between technology transfer and economic growth?*

1.3. Aims and Objectives of the Research

The research project aimed to investigate the current mechanisms of technology transfer and the aspects of technology transfer between foreign and local managers within international joint ventures in China. Its aim was to generate a model for the effectiveness and appropriateness of technology transfer. The results may ultimately assist in assessing the efficacy of technology transfer and may inform decision-makers in the recipient and donor organisations as well as investors such as the World Bank, who impose contractual provisions that require technology transfer.

In particular the objectives of the current research project are:

- From the literature, to establish a theoretical framework for the tracking of the technology transfer process;
- To establish the basic patterns of knowledge transfer through a pilot study;
- To evaluate the appropriateness and effectiveness of the study by using a main study;
- To identify the implications of the relationship between technology transfer and economic development levels.

1.4. An Overview of China's Economy

It is necessary to have an overview of China's economic reform as the current research has been undertaken in the context of the construction industry in China.

The Chinese economy presents a mixture of features of a market economy intertwined with those of a command economy. A number of key policies made these achievements possible. The household responsibility system and partial liberalisation of agricultural prices raised agricultural production and rural incomes, especially in the early years of reforms. Liberal policies toward non-state enterprises and a gradual introduction of market forces into the state-owned enterprise sector provided a powerful catalyst for rapid growth in industrial output, exports and employment (Stern, 2001).

Despite China's achievements since 1978, the Government faces significant challenges over the medium term, which can be broadly divided into two sets: achieving sustainable growth within a stable macroeconomic environment, and reducing poverty and maintaining a relatively egalitarian distribution of income and wealth.

1.4.1. Twenty Years of Economic Reform

During the last twenty years, China has seen the most remarkable period of economic growth in modern times. As Stern (2001) pointed out at Tsinghua University, Beijing[1]:

> *"China's development in this period has been characterised by a sequence of radical changes, although it has been evolutionary in the sense of building on what went before. Where the territory was uncharted, the government recognised that it was unknown and approached reforms with a pragmatic learn-as-you-go spirit. It did not matter whether the cats were black or white as long as they could catch the mice - and some experience was needed to see which cats could actually catch the mice".*

Stern described the features of Chinese market economy as decentralisation, rural reforms, and experimentation and innovation with new enterprises. Each element is

[1] Nicholas Stern is a Senior Vice-President and Chief Economist of the World Bank. Twenty Years of Reform: Achievements, Challenges, and the New Agenda is a speech delivered by him in June, 2001 at Tsinghua University, Beijing.

crucial to an understanding of how China was able to use its social and organisational capital to transform the economy and generate growth. The analysis of decentralisation, the rural economy, and new enterprises provides a context and rational for China's successful evolutionary approach to the transition, which may be summarised in a stylised way in terms of four principles or observations.

- **Step-by-step progress:** The Chinese experience is that an adaptive process of transition, proceeding step by step, can retain the social and organisational capital developed in previous stages of development and transform it in ways that enhance efficiency and productivity.

- **Build the road as one travels:** It has to be pointed out that there were strong arguments in favour of following such an evolutionary approach.

- **Climb the mountain by a zigzag path:** There is no doubt that the reform path might be more zigzag than linear.

- **Robust solutions:** The solutions to problems, as they arise, need not be perfect. The key is to look for robust solutions, that is, resilient solutions that work reasonably well across, or can be adapted to, a range of circumstances.

However, when China joins the World Trade Organisation (WTO), there will be great opportunities and challenges as well, which have been categorised by Stern, (2001) as follows:

- Enterprises, competition and the investment climate;
- Infrastructure and regulation;
- WTO accession and trade;
- Social protection and pension reform.

With each of these categories, there are institutional possibilities. However, China as in the past will choose its own approach and innovate along the way.

1.4.2. The World Bank's Forecast about China

The World Bank (1997) reports that China can meet the new challenges and sustain rapid growth, mainly because of its strengths: relative stability, a remarkably high savings rate, a strong record of pragmatic reforms, a disciplined and literate labour force, and growing administrative capacity. These strengths have driven the country's growth for the past two decades and can continue to do so over the next two.

China's continued transformation into a larger, more open economy is likely to have far reaching consequences for other countries. Similarly, as China makes the transition into the world economy, it becomes increasingly exposed to external influences.

The World Bank has made the long term projection that based on current trends China's GDP measures on a purchasing parity basis, would become one of the world's largest early in the next century. This forecast assumes that a number of assumptions are fulfilled (Flanagan and Li, 1997):

- The continuation of the reform process;
- A growing ability of the authorities to control macroeconomics developments;
- The ability of relatively underdeveloped infrastructure system support growth;
- A relatively stable political environment.

1.5. From Technology Transfer to Knowledge Transfer

Research into technology transfer has matured from the early period of emphasis on the technology itself, through general management objectives to the current state of development where interest has arisen in the appropriateness and effectiveness of the technology transfer. It has been identified that without knowledge transfer, technology transfer does not take place as knowledge is the key to control technology as a whole. Knowledge transfer is crucial in the process of technology transfer. Therefore, the focus of the research has been shifted from technology transfer to knowledge transfer.

The sequence of the research thought is presented in Figure 1.1. as follows:

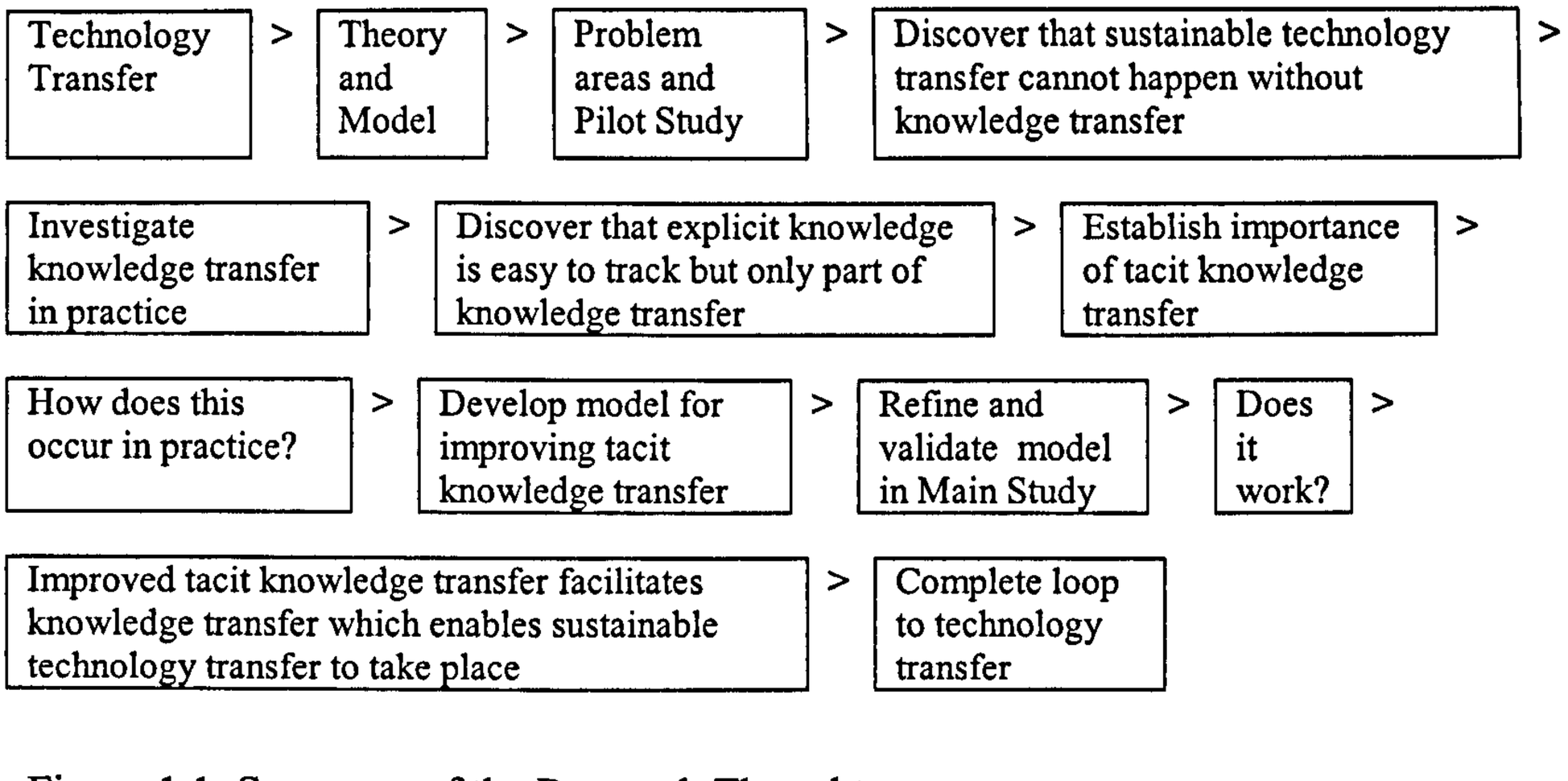

Figure 1.1. Sequence of the Research Thought

1.6. Methodology

The research project aimed to investigate aspects of technology transfer and to track the process of knowledge transfer between foreign and local managers within joint venture projects in China when they deal with method statement in construction. The design concept of the research project has been a combination of both qualitative approach and the quantitative approach. Following the literature review, both a pilot study and a main study were designed to be an integral part of the research project. Interviews were undertaken during the pilot study in a major joint venture project in China in order to obtain qualitative data while a structured survey was arranged during the main study in three sampling regions in a much wider context in China.

A psychological instrument – the assessment inventory was used both in the pilot study and the main study. It should be pointed out that significant qualitative data was collected through the interview of twenty-five (25) foreign and local managers in the pilot study while quantitative data were obtained by analysing four hundred fifty (450) copies of assessment inventories, which were returned to the researcher.

1.7. Outline of the Research Project

As it has been pointed out in the section of aims and objectives, the study focused on the investigation of the current mechanisms of technology transfer and the aspects of technology transfer between foreign and local partners within international joint ventures in China. Based upon that, the study aimed to generate a model for its

appropriateness and effectiveness. Following the theme, the theoretical framework for the current research has been built through the literature review of knowledge transfer. It should be pointed out that it might be easy to define the process of explicit knowledge while it is hard to track tacit knowledge transfer. Qualitative data were collected during the pilot study through interviews. The research model that was built during the pilot study was further refined and validated during the main study.

As the research title implies, the subject matter encompasses the following fields:

- Technology transfer
- Knowledge transfer
- Construction industry in China
- International joint venture projects

Therefore, to resolve the expanse of material content, logic and sequence, the outline and design concept of the study has to be closely related with the above focuses. Each chapter begins with a brief introduction, then examines problems and issues, and ends with a discussion.

Chapter One looks at the research problem and issues of technology transfer, aims and objectives of the current research project, an overview of China's economy, with particular examination of how the research focus was shifted from technology transfer to knowledge transfer. Chapter Two examines the definition, history, channels, theory and practice of technology transfer, the policies of EC and the World Bank towards technology transfer, and the measurement and appropriateness of technology transfer. Chapter Three reviews the definition and the important role of construction, construction industry in China, aspects of internationalisation of construction industry in China, issues and options of technology transfer in construction. Chapter Four examines theories of communication and aspects of knowledge transfer, distinction of explicit knowledge and tacit knowledge, problems and practicalities in knowledge transfer, knowledge management programme in construction. Chapter Five looks at methodological issues that relate to the current research. It examines the concept of research design and philosophical notions of the study. It explains the methods used

both in the pilot study and the main study. Chapter Six examines the various issues of the pilot study, the international joint venture projects in China. The analysis and findings of pilot study data is presented. The different positions of the three economies have been identified. Chapter Seven examines a comprehensive comparative study of economic indicators of Jiangsu Province, Henan Province and Xinjiang Autonomous Region, PRC. Chapter Eight examines the aspects of the main study that was undertaken in Jiangsu Province, Henan Province and Xinjiang Autonomous Region, PRC. The analysis and discussion of the main study data are presented. Chapter Nine looks at the research findings, validation of the research model, policy implication, and contribution to knowledge. The further research is recommended.

1.8. Scope and Key Assumptions

The current research project sets its boundaries within the context of the construction industry in China. Therefore, the pilot study and the main study of the present research were designed and arranged in China. In particular, the main study was undertaken in three different regions in terms of economic development in China while the former was carried out in a major international joint venture project in China. The unit of analysis of the study was various 'dyads' or management pairs with one foreign element and one local element, and whose roles demand that they work together (refer to figure 6.3.). From an academic point of view, the study should generate profound data and useful information. Of the many research works concerned with technology transfer, relatively few have tried to approach the tracking of knowledge transfer process, which is the core issue of technology transfer. At present there has not been much research in the area of knowledge transfer, in particular, the transfer of tacit knowledge. However, it is believed that the current research work has provided a systematic and theoretical model that has not existed hitherto in an area that has attracted little previous research.

The distinctiveness of the research programme lies in developing and validating a model with which the recipients and donor organisations as well as international funding agencies can identify the essential ingredients of a particular aspect of technology transfer, namely the transfer of tacit knowledge. This may enable the

practitioners to address the existing deficiencies in the process of technology transfer and assist in the development of more appropriate arrangement for the transfer of management know-how in theory and in practice.

1.9. Summary

This chapter has described the structure of the thesis and laid the foundations for the report. It has introduced an overview of China's economy. It presented the research problem and the justification of the research. It explained the key issues of the current research project, from technology transfer to knowledge transfer. Furthermore, the method was briefly described and justified. The thesis was outlined and the limitations were given. On these foundations, the thesis can proceed with a detailed description of the research project.

Chapter Two

The Development and the Current State of Understanding of Technology Transfer

2.1. Introduction

Technology transfer has been a focus of considerable research interest because of its close relationship with economic growth. It has been assuming an increasing significance for both developed and developing countries. In this chapter an attempt is made to establish a clear picture of the definition, theory, channels, measurement issues, and appropriateness of international technology transfer. Based upon the above elements, the study will concentrate on the identification of mechanisms of technology transfer and the processes of technology transfer. Furthermore, the chapter reviews the approaches and issues in measuring technology transfer.

2.2. What Is Technology

Technology represents the combination of human understanding of natural laws and phenomena accumulated since ancient times to make things that fulfil our needs and desires or that perform certain functions (Karatsu, 1990). In other words, technology has to create things. Miles (1995) defines technology as the means by which we apply our understanding of the natural world to the solution of practical problems. It is a combination of "hardware" (buildings, plant and equipment) and "software" (skills, knowledge, experience together with suitable organisational and institutional arrangement). Technology must be applied and maintained, which implies a demand for a further input of a suitable range of human resources and skills. It is this latter input that is at the root of the difficulty in transferring technologies between different environments.

The UN Conference on Trade and Development (UNCTAD) has provided the following definition:

> *"Technology is bought and sold as capital goods including machinery and productive systems, human labour usually skilled*

manpower, management and specialised scientists. Information of both technical and commercial character, including that which is readily available, and that subject to proprietary rights and restrictions."

Technology cannot merely be considered as a production factor, and it is not socially neutral (Mnaas, 1990). It seems fruitful to consider the concept of technology as consisting of four closely inter-linked elements: namely, technique, knowledge (normally considered as 'technology'), the organisation of the production and the product.

1. Technique

Technique covers the instruments of labour (machinery and tools), materials and the way they are brought into function by labour in the working process. Both social dynamic (working process) and social contradictions (e.g. between machinery and labour) are inherent in this element of the technology as in each of the sub-concepts.

2. Knowledge

Knowledge consists of three principal categories: applied science, skills, and intuition. The weighting between these categories of knowledge is changing historically, but in every case an adequate combination of types of knowledge must be present. *Knowledge is the 'key to control' over technology as a whole*, which can be seen both at micro-level (Taylorism) and at higher levels of social aggregation (technological dependency) (Mnaas, 1990).

3. Organisation

Technique and knowledge must be organised before they can bring results. Organisation is therefore an integral part of technology. Organisation of a working process may have technical causes, but mostly the actual choice of organisation will rest widely on social-economic causes and reflect the general social structure of society.

4. Product

The ultimate purpose of bringing technique, knowledge and organisation together is of course to obtain a product. Without including this goal, it is in fact difficult to understand the other three elements properly. It seems natural to include the product in a comprehensive technology concept, not least because in practice, the choice of product often precedes the choice of the technique, knowledge and organisation by which it is going to be produced.

Rosenberg and Frischtak (1985) pointed out that the specificity of technology has close links with the nature of the inputs to its production and of the resulting outputs. In most advanced countries, at least 60 percent of research & development expenditures are on development, namely expenditure to develop specific products or production processes. Table 2.1 represents the distribution of the costs of innovation - excluding normal investment in plant and equipment in industrial firms. Depending on the assumptions made, this distribution of expenditures predicts that between 10 and 30 percent of the inputs to industrial technology come from outside industry (mainly universities and government laboratories), and the remainder from within industry itself.

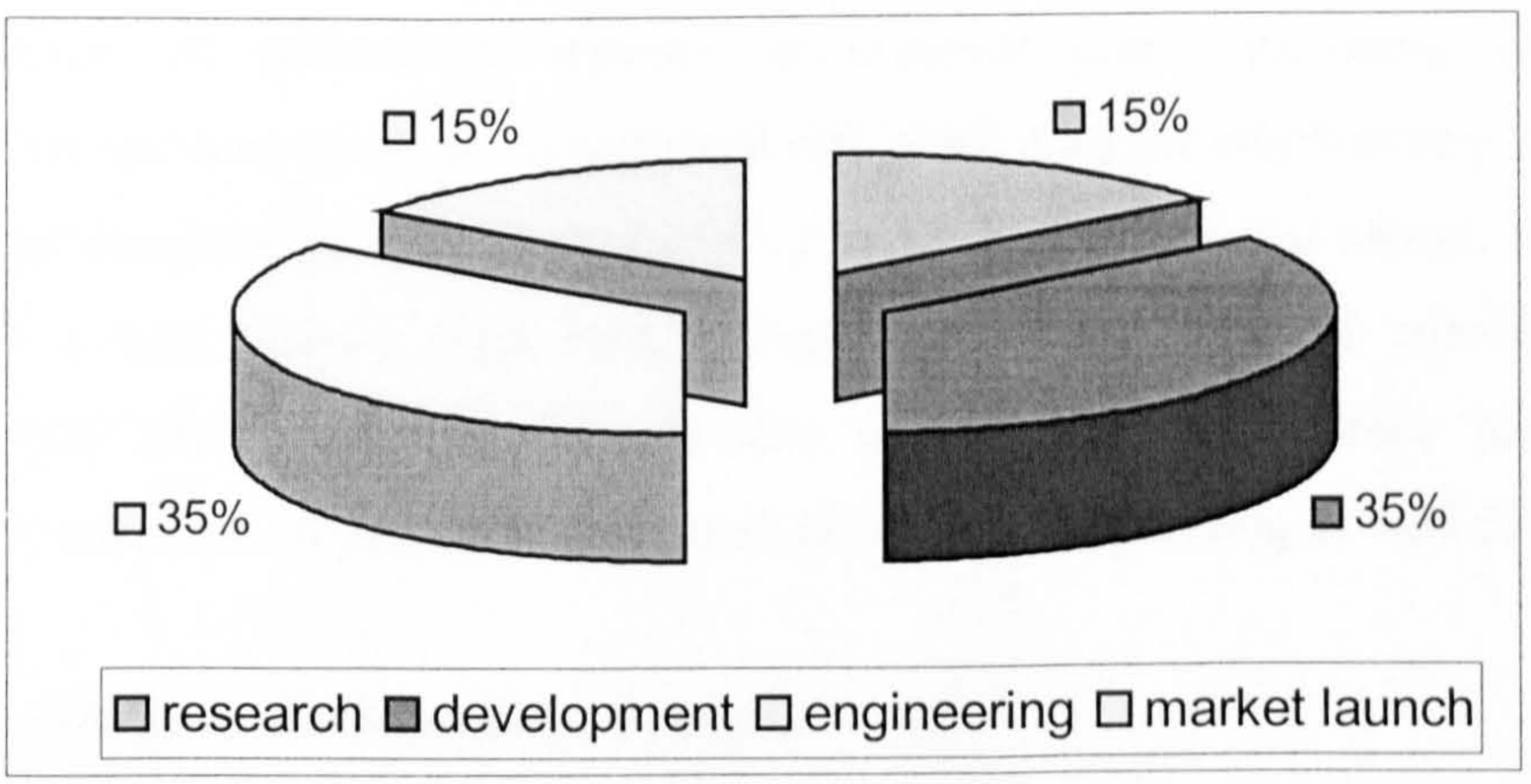

Table 2.1. Distribution of the cost of innovation (Rosenberg and Frischtak, 1985)

2.3. Technology Transfer

Technology transfer is a crucial and dynamic factor in social and economic development. Technology has been transferred intentionally or unintentionally.

Sometimes, a generator of technology has acquired a competitive advantage by undertaking the dissemination of products, processes and maintenance systems (Bradbury, 1978). Sometimes, a recipient (or transferee) has done much better than the original innovator. For example, it was the Chinese who invented gunpowder, but the Europeans who used it and developed it for world conquest. Sometimes the technology has taken a new form at each transfer, absorbing local traditions of design or local market preferences.

2.3.1. Definition of Technology Transfer

The two words "technology transfer" seem to convey different meanings to different people and different organisations. Technology transfer is defined in the Work Regulations of the United Nations, as the transfer of systematic knowledge for the manufacture of a product or provision of service (Yu, 1991). It has been defined in many other ways. According to Abbott, (1985), it is the movement of science and technology from one group to another, such movement involving their use. Traditionally, technology transfer was conceptualised as the transfer of hardware objects, but today also often involves information (e.g., a computer software program or a new idea) that may be completely devoid of any hardware aspects.

The concept of technology transfer is comprehensive, including commercial transactions and non-commercial technical aid. If this transfer involves any factors that are beyond domestic control, the transfer takes on an international aspect, the content of which covers license agreement, technical services, technical consulting, etc.. International technology transfer includes co-operation production, joint-venture operation, operation of project in co-operation, project-contracting as well (Yu, 1991).

2.3.2. Significance of Technology Transfer

Technology transfer is important not only for world understanding, but also for taking advantage of progress in different parts of the world in applying modern science to economic activity. At the same time, technology transfer is a shortcut not only for the Third World countries, but also for all countries in the world. However, success in technology transfer is related to its appropriateness (Samli, 1985). If the transferred technology is not appropriate for the needs and conditions prevailing in the receiving country, no matter how superior or efficient that technology may be, it will be rejected.

2.4. The Recent History of Technology Transfer

In its broadest sense, technology transfer has occurred since the very earliest stages of the human development, and social and economic development. Having identified the definition and the significance of technology transfer, this section examines the recent history of technology transfer from the 1960s to the 1990s. Knowledge management that emerged as a focus of business attention in late 1995 [1] began to prevail as technology transfer began to fade since 1990s. Knowledge management and knowledge transfer has become popular until recently.

2.4.1. UN Conference on Science and Technology

The interest in technology transfer on a global scale can be traced to the early 1960s. The concept of "technology transfer" was debated during the UN Conference on Science and Technology (UNCSAT) which was held in Geneva in 1963. The advanced countries prepared their scientific and technological wares and the developing nations were expected to pick and choose those aspects that might help solve their development problems. One distinguished British Nobel Laureate referred to the UNCSAT as 'a supermarket' (Oldham, 1987). The difficulties of access to technology and the costs of technology were not seriously considered. In fact the real problems of technology transfer were hardly discussed at all.

2.4.2. The Organisation of American States

According to Oldham (1987), the Organisation of American States was the earliest to recognise the developmental importance of technology transfer and initiated their studies in Latin America. They built on work by Constantine Vaitsos that had already begun in Colombia and set up a network of studies in most Latin American countries.

2.4.3. UN Conference on Trade and Development

UN Conference on Trade and Development (UNCTAD) is one of the first international organisations to recognise that there were problems associated with the transfer of technology to developing countries. In its second conference in New Delhi in 1968, UNCTAD commissioned a paper that used Organisation for Economic Co-operation

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[1] Examples include: The Journal of Knowledge Management, Knowledge Management, Knowledge Management Magazine, Knowledge Management Review, etc.

and Development statistics to compare the technological balance of payments between different countries. Some industrialised countries sold more than they purchased and their balance of payments was positive, whereas developing countries had the reverse. Therefore, UNCTAD argued that this 'invisible' trade in technology warranted further study and began a major program to identify the main policy issues about technology transfer, which they feel, should be of concern to Third World governments.

2.4.4. Technology Transfer in the 1970s

The result of the study of technology transfer in Latin America grabbed the attention of the developing world. With technology transfer, the multinational companies appeared to be making excessive profits out of their sales to Latin America. Technology transfer aroused increasing interest of academics. At the same time the issue of technology transfer had become so politically charged that it featured on the agenda of a meeting of Latin American foreign ministers.

Throughout the 1970s, technology transfer remained a major political issue (Oldham, 1987). For 10 years UNCTAD tried to negotiate a Code of Conduct on Technology Transfer which would be binding on both suppliers and recipients of technology. The debate between government representatives in Geneva's UNCTAD headquarters became extremely acrimonious, and much time and money was spent on negotiations that were eventually fruitless. There was argument over excessive profits and the price charged for technology transfer between the developed and the developing countries.
At the same time many developing countries set up government mechanisms to monitor and control the flow of foreign technology. These countries followed what came to be called 'defensive' technology transfer policies. They aimed at improving the contract terms of those that were permitted entry into the country.

2.4.5. Technology Transfer in 1980s and 1990s - Fear of Competition

The prominent features of the interrelated developments of international technology transfer in the1980's are summarised by Singer (1991) as follows:

- Internationalisation of production
- Globalisation of competition

- The proliferation of new information technologies and several types of organisational innovations relating to design, production and marketing of industrial goods and services.

In the 1980s, the concerns about contract conditions and terms began to fade as a new set of issues began to take place. This was mainly caused by the success of such countries as Brazil and South Korea in competing with their manufactured goods in international markets. This led companies in the developed world to be even more reluctant to part with their 'core' or essential technologies at whatever price.

2.4.5.1. Technology Transfer and EC Policies

During the 1980s and the early 1990s, European Commission policies and programmes on technology transfer opened new ways of thinking about innovation support systems and shaped a number of infrastructures and services for such purpose. The most important have been contributions from the Strategic Programme for Innovation and Technology Transfer (SPRINT), the Regional Innovation and Technology Transfer Strategies and Infrastructures (RITTS), the pilot-action of Regional Technology Plans (TRP), and recently, the Fifth Community Frame-work Programme for Research and Technological Development. These programmes have accumulated important experiences in technological co-operation and created generic tools for technology transfer and innovation diffusion (Komninos, 1997).

2.4.5.2. The World Bank and Technology Transfer

The World Bank is one of the organisations that are most interested in technology transfer. It supports the view that the development of local consulting firms can best be advanced through ventures with foreign firms. In 1993, however, the World Bank adopted an explicit policy of requiring a commitment to technology transfer from its contractors to the construction industries of the host country (Abbott, 1986).

The World Bank has an explicit policy of promoting technology transfer by using international consulting firms to support and strengthen local capacities. The World Bank is now keen to promote technology transfer and frequently advises that foreign companies will not get contracts of the Bank projects unless they form meaningful partnerships with local companies (Carrillo, 1993). However, there is a lack of

mechanisms to ensure real technology transfer. In her study of international joint ventures, Carrillo's findings show that international joint-venture between contractors in the developed and developing countries are recognised as a potential means of enhancing the construction expertise of nationals of developing countries, and offer many advantages and disadvantages to its partners.

2.5. Technology Transfer: Issues and Practice

It is clear that technology can no longer be regarded as information that is generally applicable and easy to reproduce and re-use but as a highly differentiated range of techniques (Tsang, 1997). Neither can technical knowledge only be interpreted in terms of production technology, as Kogut and Zander (1992) point out. People and organisations possess socially oriented as well as technologically oriented know-how (Menzler-Hokkanen, 1995) and a firm's technologies are embodied in its human and organisational as well as its physical resources. Successful transfer of hard technologies often has to be accompanied by the transfer of soft technologies like management know-how (Hendryx, 1986). These are particularly critical since they are sensitive to local cultural and environmental conditions (Bakuli, 1994).

This section reviews a range of issues and practices of technology transfer, which covers technology transfer process, channels and evaluation of technology transfer.

2.5.1. Technology Transfer Process

Technology may be transferred between persons, between organisations, from a research centre or educational institution to enterprises in industries and between regions and countries. In its most common usage, technology transfer normally refers to formal and direct arrangements based on an agreement between a buyer and a seller or a non-commercial arrangement between a donor and a beneficiary. However, a funding agency can play an important role in the arrangement. Ofori (1994) illustrates the process of technology transfer between countries as shown in Figure 2.1.

2.5.2. Technology Transfer Channels

As identified by Sharif (1983) the complexity of technology and transfer process, motivations and the practices of the transferors, attitudes and the abilities of the

transferees and the government policies are the major issues of technology transfer. Reddy (1996) identifies six barriers to technology transfer: political, regional, social, religious, ethical, and economic. After a survey of the literature of technology transfer, Rapoport (1985) summarised the channels of technology transfer as follows:

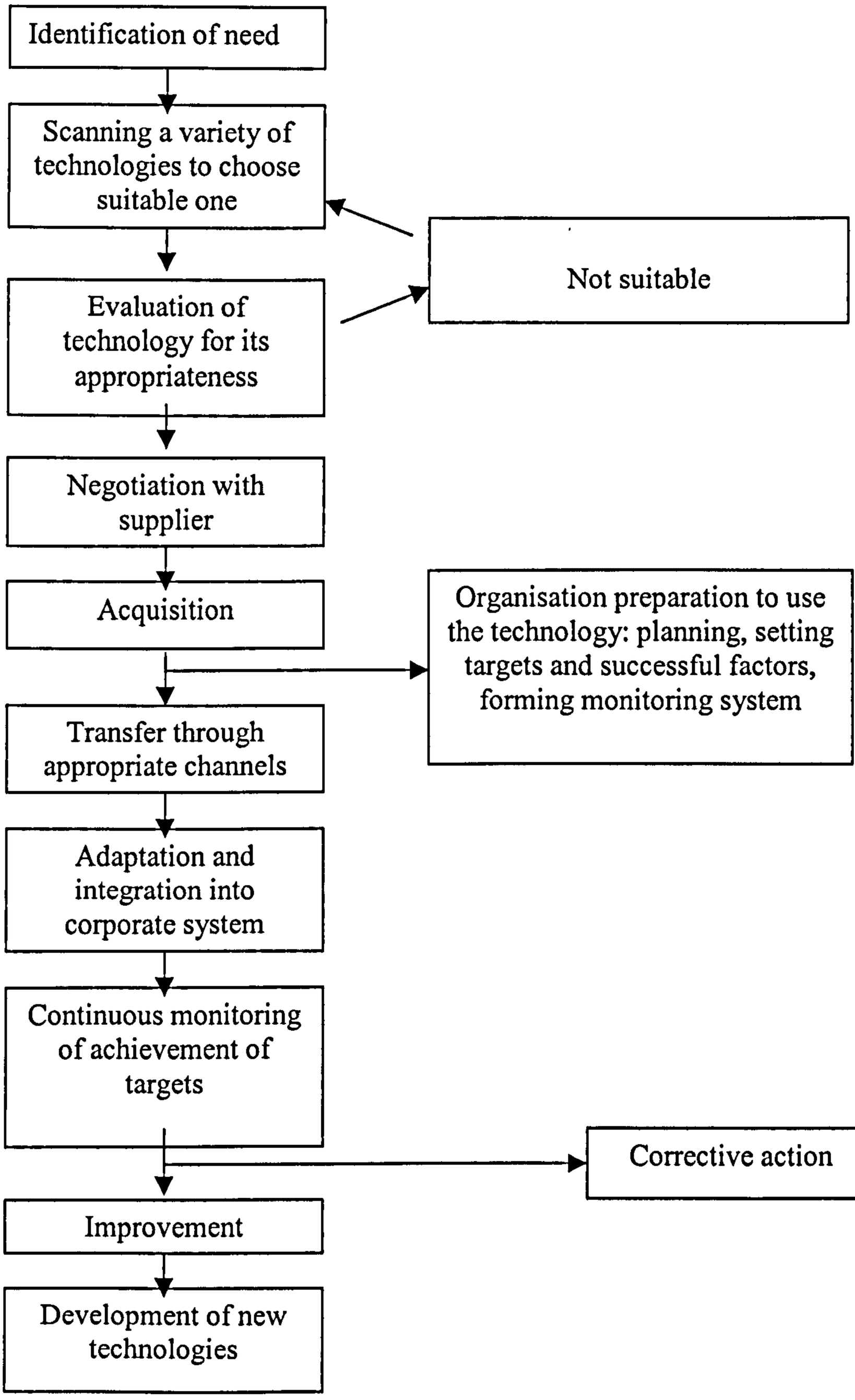

Figure 2.1.Technology transfer process (Ofori, 1994)

- Direct foreign investment
- Sale of turnkey plants
- Joint venture
- Co-operative research arrangement
- Export of high technology products and capital goods
- Reverse engineering
- Exchange of scientific and technical personnel
- Science and technology conference
- Trade shows and exhibits
- Education and training of foreigners
- Commercial visits
- Open literature (journals, magazines, technical books and articles)
- Industrial espionage
- End-user or third country diversions
- And government assistance programs

The technology lag in the construction industries of the developing countries makes technology transfer more necessary and potentially viable (Abbott, UNCTC, 1989). Developing countries should promote strategic alliances, such as joint ventures between local and foreign contractors in order to develop their construction industries (World Bank, 1984).

2.5.3. Evaluation of International Technology Transfer

Technology is mainly specific knowledge about highly differentiated products and production processes that accumulates step-by-step in firms (Rosenberg and Frischtak, 1985). The successful assimilation of technology from outside sources depends on an in-house capacity not just in research and development, but also in production engineering. Assimilation invariably involves adaptation, so that the diffusion of an innovation cannot be neatly separated from innovation itself.

The sources, nature, and mechanisms of international technology transfer vary considerably from sector to sector. In sectors where firms are in general supplier-dominated, technology comes mainly already embodied in production machines. In

production-intensive firms, the key technology relates to constructing and operating large-scale plant and is transferred international mainly through know-how agreements. In sectors supplying production equipment, however, technology is transferred internationally mainly through reverse engineering and through local linkages with the production engineering departments in production-intensive user firms (Rosenberg and Frischtak, 1985). In science-based firms, the key technology emerges mainly from industrial research and development and in some cases from academic research.

2.6. Theories of Technology Transfer

This section examines the theoretical issues of technology transfer, which covers the models of technology transfer, mechanism of technology transfer and approaches and problems in measuring technology transfer.

2.6.1. A Basic Model of Technology Transfer

Cultural barriers are perhaps one of greatest challenges to a successful transfer of technology. Penetrating cultural barriers implies the sender's perceptions as to the receivers' needs. As far as the technology transfer is concerned, an important principle is congruence between the sender, the technology and the receiver.

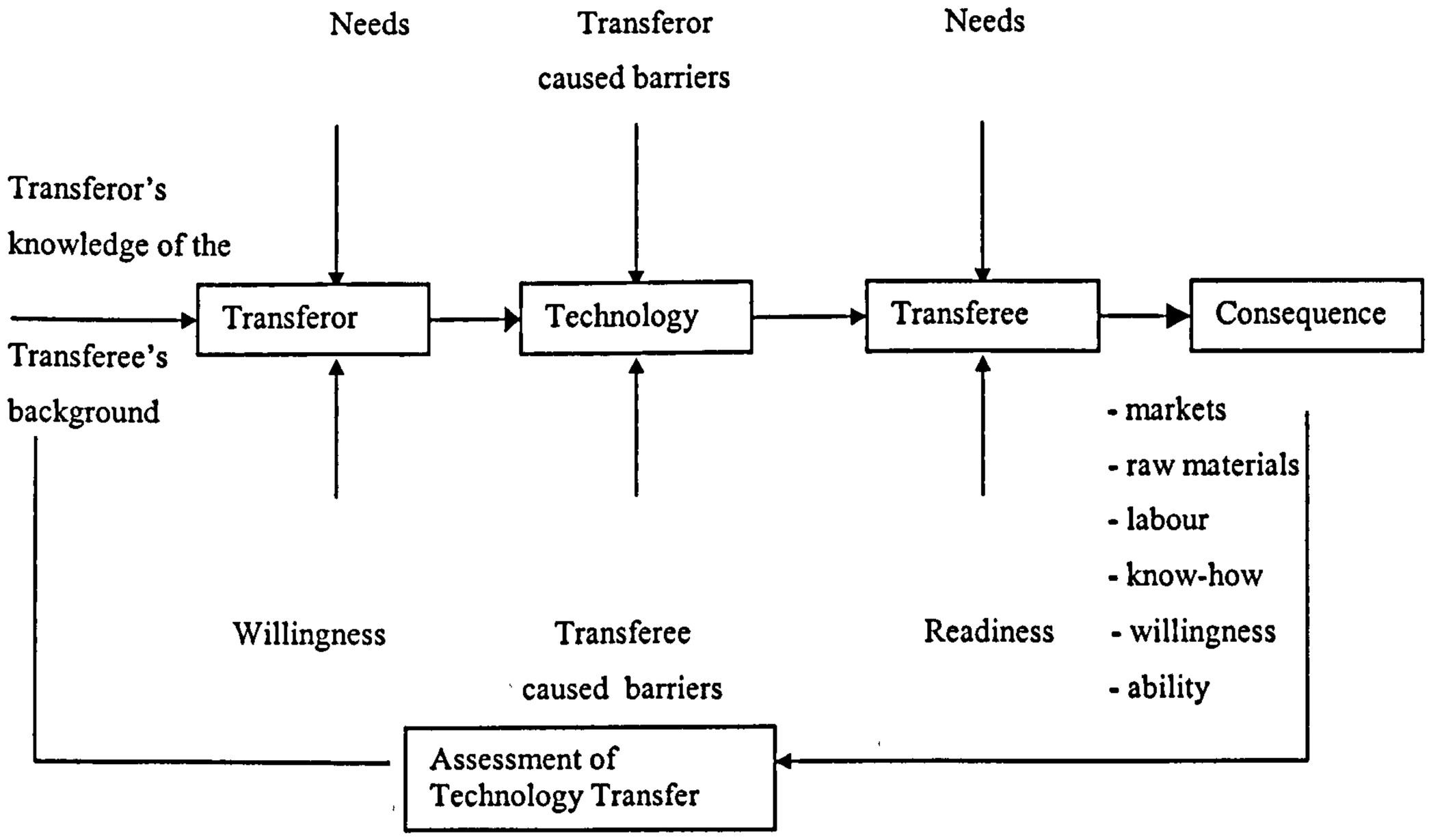

Figure 2.2. A basic model of technology transfer (Samli, 1985)

In fact, technology transfer benefits both developing and developed countries. Regarding where the technology is developed how it is utilised who uses it and for what purpose, Samli (1985) considered six dimensions of technology related to the following specific aspects: such as geography, culture, economy, people, business, and government. He models technology transfer as shown in Figure 2.2.

2.6.2. Product Life Cycle Theory of Technology Transfer

Walsh (1987) suggests that the typical approach of the foreign organisation is to attempt to use familiar technologies rather than develop production process skills of the existing labour force. This approach provides short-term solutions to shortfalls in indigenous capacity and a residue of the imported technology can be expected to remain in the country, contributing to a longer-term improvement in capacity. The extent to which this happens naturally, however, is debatable. Lam (1997) argues that the difficulties in the transfer of knowledge arise not simply from the tacit nature of knowledge itself, but from differences in the degree of tacitness of knowledge and the way in which it formed, structured and utilised in different countries.

Technology transfer has played an important role in the international economy and technological co-operation, the dissemination of science and technology and promotion of international trade. According to Chen, (1994), the importance of technology transfer has been one of the main Chinese aims in attracting foreign investment. The unsophisticated technology transferred to China by foreign firms resonates with the predication suggested by product life cycle theory. The theory states that as the technology of a product becomes more standardised and static, the product migrates to lower-income countries where labour cost becomes a more important basis for comparative than research and development. They were in the final stage of their cycle, namely the standardised stage, where management skills and labour costs rather than technical skills, were critical (Chen, 1994).

2.6.3. The Mechanisms of Technology Transfer

Much of the technology developed in industrial countries is freely available to the underdeveloped countries and constitutes part of the common fund of human knowledge (Abi-Saab, 1967). This is true not only of purely scientific knowledge, but also of a lot of specific information concerning production processes. Apart from

scientific publications, such information can be obtained through academic and government exchanges, foreign experts, scientific and practical training of nationals abroad, etc. It can also be acquired by attending international scientific and technical conferences, meetings or seminars held by the international scientific and technical organisations or institutions.

In the light of the political and economic conditions of the countries concerned, the patterns of transfer of technology from enterprise to enterprise vary enormously. According to Abi-Saab (1967), transfer of technology can be:

1. Operated in the first place from a foreign enterprise to one of its branches or to a wholly owned subsidiary in the less developed country. In this case, the transfer of technology is part of direct private foreign investment in that country.

2. Arranged by the patentee to sell the use of the process to a producer in the less developed country through a license.

3. Operated with 'turn-key' formula. According to which the foreign enterprise undertakes to build all the installations and the machinery necessary for the working of the process. The consideration for the use of the process will be part of the global price.

One basic consideration becomes apparent: as far as technology transfer is concerned, what counts most is not the legal formula employed to effect the transfer, but that it directs foreign investment, licensing or joint venture.

The foreign enterprise may be attracted to the less developed countries by raw materials, cheap labour and access to new markets, but the result will be a dual economy, as exists in many countries. Moreover, it is not enough to work the process in the country. Real implantation may require its adaptation to local conditions, such as climate, availability of factors of production, tastes, etc. In this respect, the foreign staff may learn from their local counterparts as well as teach them. The development of the product on the spot is thus a very important aspect of the successful transfer of technology and its implantation (Ramaer,S., 1967).

2.6.4. Measurement of Technology Transfer

In categorising the conceptual and measurement problems, the key factors are determinants, channels, and effects of international technology transfer. (Samli, 1985). What makes the conceptualisation exceptionally difficult is the specificity of technology in terms of its highly differentiated inputs and outputs. The sources, nature and mechanisms for international transfer of technology vary considerably from sector to sector.

2.6.4.1. Approaches to Measuring International Technology Transfer

There are three approaches in measuring international technology transfer summarised by Samli (1985) as follows:

1. The macroeconomic approach that restricts its coverage to transfers that generate monetary payments and receipts and which relies on balance of payments, often highly aggregated data for their measurement.

2. The microeconomic approach that restricts its coverage to selected specific firms and/or sectors in terms of case studies and which relies on firm-specific, often primary data that go beyond monetary payments and receipts.

3. The microeconomic approach which restricts its coverage to patentable technology information as a proxy for technology and relies on patent citation data for measuring the international transfer of such information.

It should be pointed that Samli has summarised only the economic measures at both macroeconomic and microeconomic levels.

2.6.4.2. Problems in Measuring Technology Transfer

It is clear that the above literature has built a ground in understanding the mechanism and process of technology transfer; however, the measurement of technology transfer is still a hard task. Samli (1985) pointed out six difficulties as follows:

1. The international flow of public technological information (scientific and technological journals, patent descriptions) and of firm-specific information (drawings

and blueprints, operating manuals), are only part of the process of international technology transfer. They do not capture reverse engineering, the transfer of person or institution-embodied know-how, flows through academic institutions, or technology embodied in machines.

2. Monetary flows resulting from inter or intra-firm licensing agreements can, in principle, capture flows of know-how. Patent license can be distinguished from know-how licenses. Within the latter it is useful to distinguish between sums involved in transferring otherwise secret information and those involved in transferring person-embodied know-how.

3. For certain important channels of international transfer, there is not sufficient information available. Therefore, it is difficult to separate out the value of embodied technology.

4. As has been seen, the assimilation of outside technology always involves considerable costs to those doing the assimilating and requires activities that resemble in many ways those necessary for the creation of technology. A good proxy measure of the capacity for imitation is therefore the level of industrial activity in R&D, and production. Although there are good data on R&D activities in the OECD countries, there is nothing systematic on PE activities.

5. Technology license payments in the past were understood to be proxies for technology imports and industrial R&D expenditures to be proxies for the production of indigenous technology. This view is mistaken. There are many other channels for the import of foreign technology than licensing, and industrial R&D activities not only create indigenous technology but also assimilate and adopt technology of foreign origin.

6. Even if better data are collected on each of the channels of international technology transfer, there remains the problem of putting them together in a common measure of volume and value.

2.7. Summary

What has become apparent is that the critical issues of technology transfer between developed and developing countries should be sufficiently addressed. Much has been published about the significance of international technology transfer, but relatively little touches on ensuring of effectiveness or appropriateness of the technology transferred. Furthermore, it has been pointed out by researchers that technology transfer requirement should be specified in a contract with a highly structured system. To date no systematic and theoretic model is available to establish the essential ingredients for this type of transfer.

Chapter Three

Technology Transfer in Construction Industry in China

3.1. Introduction

Following the examination of aspects the construction industry, the chapter will review the present situation of construction industry in China. Then the chapter will address the issues of technology transfer in the construction industry and the internationalisation of construction industry in China. Furthermore, the chapter will address technology transfer involvement in construction industry, in particular, the issues and options in construction technology transfer. Finally, the chapter will address the technology transfer issues in the construction industry in China.

3.2. The Construction Industry

The construction industry plays a major role in economic development in both developed and developing countries with its special characteristics compared with other industries. It undertakes the production of various construction products. In other words, the construction industry is composed of construction and reconstruction of housing, infrastructure, the installation of various equipment and facilities, the surveying and designing of various construction products for various material production entities, and non-material production entities of national economy.

3.2.1. Definition of Construction

Construction is a traditional industry, whose background dictates that it has not developed at the same pace as that of other industries (Scott, Ponniah and Saud, 1997). Whether it is justified or not, this industry is often perceived as old fashioned and reluctant to come to terms fully with the modern business world of today. Horner and Zaja (1991) argue that it would be a loss in competitive advantage if new management techniques, such as management know-how, are not properly considered and adopted, no matter how sensible it is that new ideas are not adopted until they have been tried and tested. Raftery *et al.* (1998) review recent developments in the construction industry and identify the major trends that have helped polarise the financial and technical superiority of the developed countries and the corresponding

inferiority of the developing countries. Raftery *et al.* (1998) argues that technology transfer, in the long run, could be one of the important ways to fill this gap. Joint venture between multi-national companies and local companies is an effective approach and preferred vehicle.

3.2.2. Role of Construction

The construction industry plays a major role in economic development in the less industrialised nations since it constitutes a significant portion of both gross national product and of employment (Abbott, 1985). Indeed, the creation of physical facilities constitutes more than one half of the gross domestic investment of both developed and developing nations. The construction industry also plays a key role in satisfying a wide range of physical, economic and social needs and contributes significantly to the fulfilment of various major national goals. The industry's size, the nature of its operation, and its presence in every developmental activity make it an attractive area for the transfer, adaptation, and development of technologies consistent with the development goals of emerging nations.

3.2.3. Stages of Development of the Construction Industry

The development of a local construction industry follows economic development fairly closely. Abbott, (1985) identified five basic stages in the development of an indigenous contracting industry as follows:

1. Foreign firms play important role in construction activity. Foreign firms have the expertise and local firms do not, or it may be that local firms do not even exist, except perhaps as informal jobbing contractors.

2. Local sub-contractors begin to develop perhaps to take over small parts of the foreign contractor's work. These sub-contractors may be formed by local entrepreneurs, which are able to supply labour.

3. Local contractors execute small projects. This is a significant step, for these firms are taking commercial risks and are probably completing projects that foreign contractors are not interested in.

4. Local contractors take over most local work. Perhaps by keeping costs down, these firms compete successfully with foreign firms, but they also undertake joint ventures with the foreign firms for larger contracts.

5. Local contractors seek new work abroad. Initially this may mean that the contractors bid for work in neighbouring countries but there is also the possibility of bidding for contracts further afield.

It is clear that the relative importance and the demand of technology transfer in this process is demonstrated not just at the joint venture stage, but also earlier, since the transfer stimulates the growth of local contractors and consultants, and there are consequent passes on effects.

3.3. The Construction Industry in China

China's economy is now one of the largest economies in the world, the rapid economic expansion has also created one of the largest construction market in the world (Bon, 1997). The increase in economic activity has generated and will continue to do so, a heavy demand for construction for at least the next 10 years. Therefore, the heavy demand for construction, caused by the rapid economic growth, cannot be satisfied by China's prevailing resources, either physical, technological or managerial. The construction industry in China has suffered for many years as a result of long construction cycles, inadequate planning and programming of projects and poor quality of workmanship. Therefore, an increasing number of construction projects are promoted for international competitive bidding. In this way, not only can advanced technology be introduced, but also advanced management practices and methods can be imported from the advanced countries.

The construction industry in China was not recognised officially as a separate industry until 1983. In the past, it was viewed as a subordinate part of the Basic Construction (government investment). Therefore, the construction industry was regarded as producing no financial value through design and construction activities. The creative contribution of construction industry to the national economy was completely denied. In fact, the construction industry plays a very important role in the national economy.

China has 88, 329 construction enterprises, (including 4, 643 state-owned, 9, 837 collective-owned and 73, 849 rural construction companies), with a total workforce 25 million, about 10% of the total employment of the country (Chen,1997).

Another feature of the construction dimension in China in that there is a large increase of externally financed projects. In addition to providing project finance, international funding agencies are keen to address the issues of shortening the gaps between developed and developing countries, namely increasing the future capacity of the indigenous industry to meet the demands placed upon it. The principal vehicle for achieving this is technology transfer.

3.3.1. Private Firms in China's Construction Sector

Economic reform is succeeding in China's construction industry. As a result, China's privately owned construction companies now plays an important role in the country's construction sector, which produce 60 percent of its output and account for 85 percent of the sector's profits. So far, more than 13,000, or more than 28 percent, of China's assets- and quality-certified construction firms have undergone structural reforms in accordance with contemporary management standards and practices (Economic Daily, 1999). These companies include 1,844 joint-stock corporations, 7,833 limited companies, 1,983 solely state-owned enterprises, 1,167 shareholding co-operative firms, 270 enterprise groups and 23 listed stock companies.

China's private construction companies now generate RMB 500 billion (US$60.39 billion) in annual output value, which is 60 percent of the sector's total. These private firms also produce RMB 10.6 billion (US$1.28 billion) in annual profits-a huge 85 percent of the total for the entire construction sector.

3.3.2. Internationalisation of the Construction Industry in China

With the accession to the World Trade Organisation (WTO), as the economic reform is going to depth, China will be facing both opportunities and challenges. The construction market in China is becoming more and more internationalised. However, the following factors are implications of internationalisation of construction industry in China.

1. Increase of the Projects Financed by the World Bank

The number of construction projects financed by the World Bank and also by the Asian Development Bank has been increasing since the World Bank recommenced the provision of loans to China at the beginning of 1980's. So far, the total amount of loans provided by the World Bank to China has exceeded US$ 20 billion (Sun, 1997). There are about 200 projects financed with a loan from the World Bank, which are widespread in various industries, such as construction, agriculture, transportation, communication, energy, social and educational development, and so on. Some notable examples are: the projects of Lubuge Hydro-electric Power Station, Ertian Hydro-electric Power Station, Jing-Jin-Tang Express Way, and Xiaolangdi Hydro-electric Network.

2. Project-Contracting Overseas

China has made great achievements in the field of international economic and technological co-operation, project contracting in the international construction market. By the end of 1995, there were 578 domestic construction companies in China which were approved and authorised by the Ministry of Foreign Economy and Trade Co-operation to undertake international construction project-contracting and labour service, with a total contract value US$ 50 billion, a turnover US$ 32.1 billion, a workforce dispatched to the foreign countries 1.104 million and a business coverage of more than 170 countries in the world (Li, 1997).

3. Foreign Joint-Venture Investments

Since the reform and opening to the outside world, China has absorbed a large amount of foreign capital through various channels. By the end of 1996, 283,793 foreign investment projects were approved in China, with a total contract value US$ 469.325 billion and a total value paid up US$ 177.217 billion. More than 140,000 joint ventures are in good operation, with a total employment 17 million (Ma, 1997). There is an increasing number of the multi-national firms in the world which are coming to China for investment. Among the top 500 large and multi-national firms in the world, more than 200 have made investments in China. There are 132 large multi-national firms, which have established offices in Beijing alone. Technology-concentrated projects have increased because of the coming of the large and multi-national firms. With the establishment of many Sino-foreign joint-ventures, investment has been

brought in and greatly increased the number of the infrastructure projects, such as expressways, water plant, cement plant, power plants; commercial facilities, such as, department stores, shopping centres, as well as high standard multi-function buildings.

4. Investment Overseas

At the same time, China has made a large investment in various countries in the world through its multi-national companies. A lot of companies set up their factories and built facilities in many countries in the world. For example, China State Construction Engineering Corporation (CSCEC), the largest construction company in China, with 22,000 employees, 8 branch companies, 6 design institutes, 1 technical school and 1 training centre, 35 regional branches and 8 specialist branches, has established 63 overseas branches and offices and made investments in many countries all over the world (Flanagan and Li, 1997).

3.4. Technology Transfer in the Construction Industry

The international construction industry has long been involved with different forms of technology transfer (Abbott, 1985). For many companies, whether they are consulting engineers, engineering design organisations or contractors, technology transfer is just a new term used to describe the training element in foreign construction that they have often had to undertake.

The rising demand from public and private clients in developing countries, however, supported by the international aid organisations for a technology transfer element in contracts let to foreign companies, has led to a new pre-occupation with its definition and implementation.

3.4.1. Construction Technology Transfer Vehicles

During technology transfer the transferor does not always provide the transferee with solutions to specific problems. As a matter of fact, an effective transfer occurs when technology is requested, transmitted, received, understood, applied, diffused widely and improved. Ofori, (1994) models the construction technology transfer vehicles in Figure 3.1.

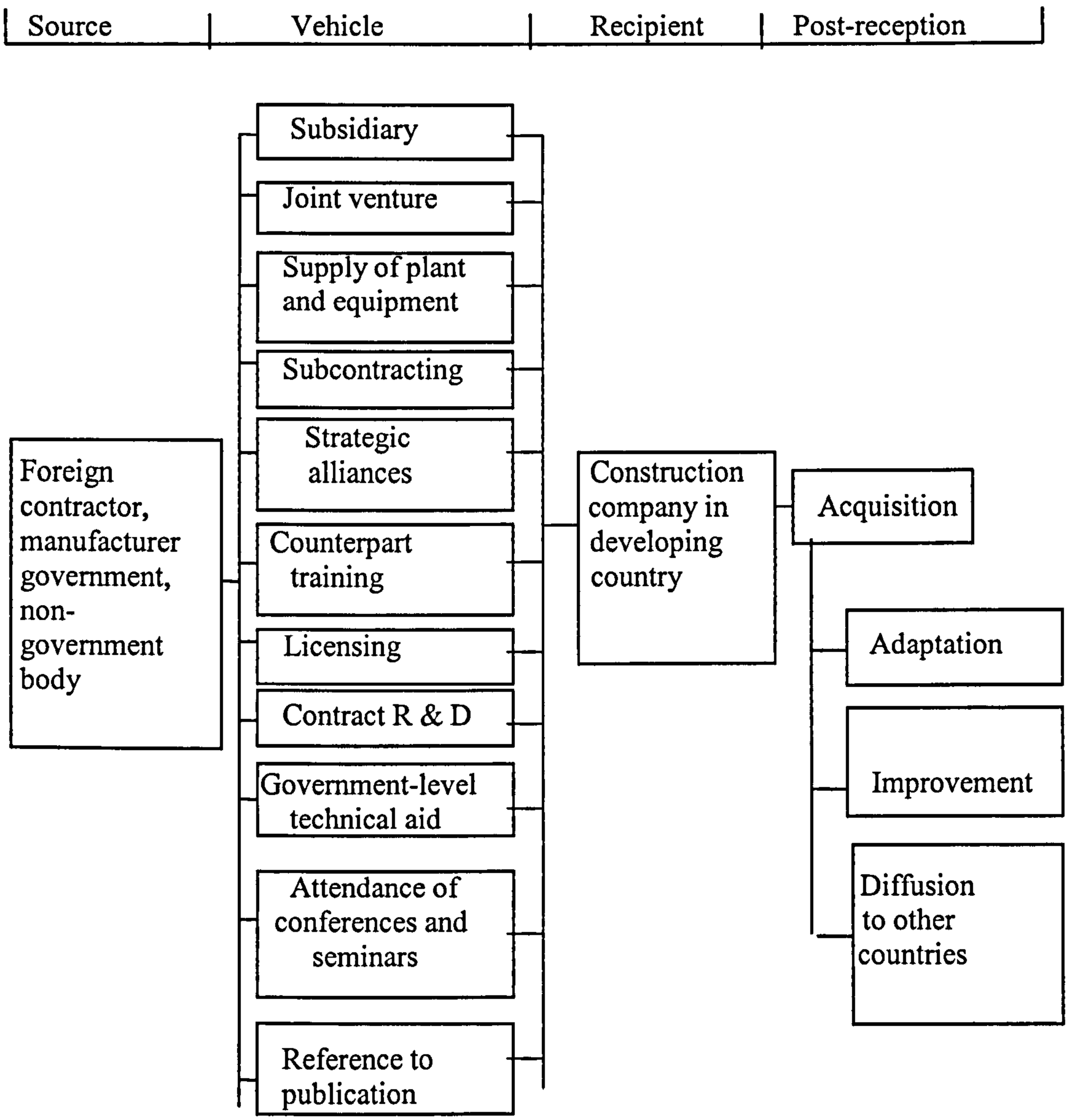

Figure 3.1. Construction technology transfer vehicles (Ofori, 1994)

3.4.2. Identification of Appropriate Construction Technology

The suggestions of the World Bank (1979) for the identification of more appropriate construction technologies and techniques are:

- *Appropriateness of goal.* Does the technology support the goals of development policy?

- *Appropriateness of product.* Is the final product or service delivered, useful, acceptable and affordable to the intended users?
- *Appropriateness of process.* Does the production process make economic use of inputs?
- *Cultural and environmental appropriateness.* Are the production processes, the products delivered and the institutional arrangements compatible with the local environmental and cultural settings (The World Bank, 1976).

A United Nation Development Programme (UNDP) study for determining the most appropriate construction technologies and techniques has listed the following criteria (UNDP/World Bank, 1979):

- Amount of local labour incorporated - objective to maximise
- Amount of indigenous material used - objective to maximise
- Functional performance
- Replicability
- Capital cost
- Life cycle cost
- Time to implement
- Amount of foreign exchange component - objective to minimise
- Environmental impact
- Social impact
- Economic impact

3.4.3. Patterns of International Trade in Construction

Bon (1997) describes that national economics can be considered in three categories of countries:

- Advanced industrialised countries (AIC)
- Newly industrialised countries (NIC)
- Less developed countries (LDC)

Based upon the above premises and international survey of construction, Bon (1997) models the present pattern of international trade and technology transfer in construction services as shown in Figure 3.2. The arrows in the figure show the direction of current patterns of trade in construction services.

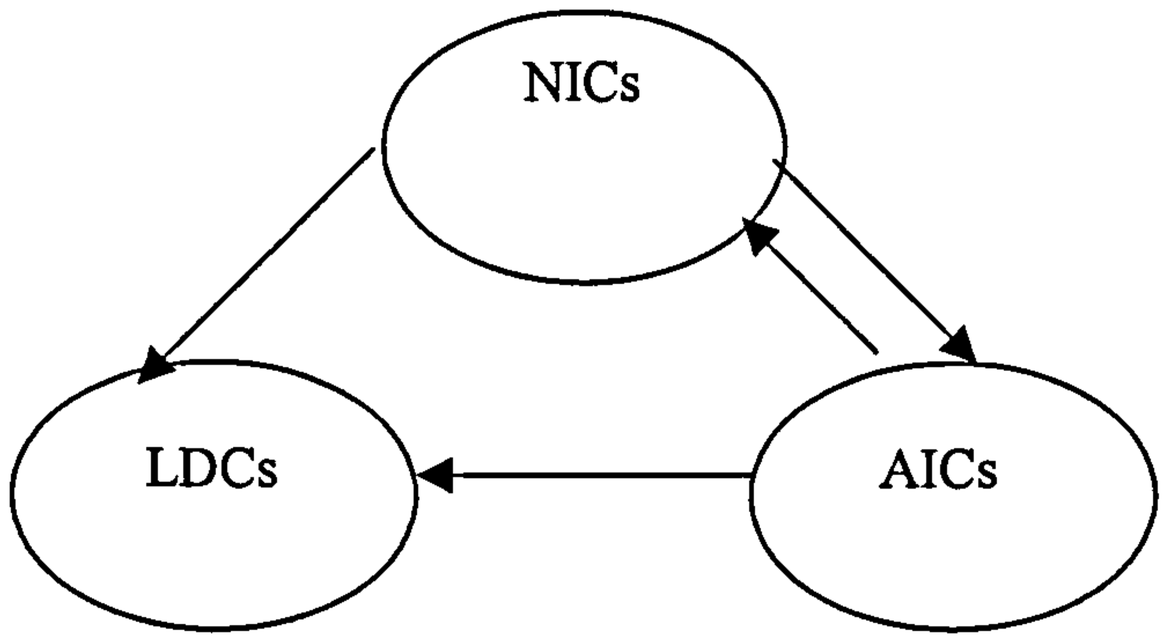

Figure. 3.2. Present pattern of trade in construction services (Bon, 1997)

Evidence from India, Turkey and South Korea supported the pattern. China is another example. Since the economic reform in 1978, the Chinese construction industry has played an important role in the international construction market.

A large proportion of construction activity remains local, regional or national at all stages of development. The segment of the construction sector that engages in multinational, continental, or global construction activity may be growing. The global market in construction services is far from restricted to advanced industrialised countries. Both less developed countries and newly developed countries already play important parts in the global market (Drewer, 1990). At present, advanced industrialised countries may continue providing highly specialised construction services to newly industrialised countries and less developed countries. These services may focus on high-technology or capital-intensive project, as well as on highly specialised maintenance and repair construction, which is growing in advanced industrialised countries (Bon, 1996). Technology transfer from the advanced industrialised countries is likely to be based around professional expertise being transferred to the newly industrialised countries and less developed countries. Indeed in 1993, the World Bank adopted an explicit policy of assistance to promote the growth of borrower countries in construction industries (Langford, 1995).

3.5. Construction Technology Transfer: Issues and Options

This section will address the attitude of the governments, the attitude of the World Bank in terms of technology transfer in construction and the barriers to technology transfer in construction.

3.5.1. Attitude of the Governments

Governments everywhere (and especially in the developing countries), have sought to control, guide and encourage technology transfer through various means which were summarised by Ofori (1992) as follows:

- Training components are made mandatory in joint-venture agreements between a foreign and local partners, in the terms of engagement of foreign companies for construction projects or in agreements for direct investment by manufacturing enterprises.

- Guidelines for licensing agreements are formulated and administered which prohibit the transfer of certain technologies, outline prices or pricing mechanisms or suggest terms of contract.

- Support is provided for technical information and extension services to facilitate the diffusion of technologies.

3.5.2. Attitude of the World Bank

The World Bank encourages technology transfer in the construction industry and favours the formation of joint ventures, which appear to be the most widely preferred vehicle of technology transfer in construction. In addition, public, private sector clients, and leading agencies have supported technology transfer in construction industry. For example, As far as Xiaolangdi Multi-purpose Dam Project[1] is

[1] Xiaolangdi Multi-purpose Dam Project, across the Yellow River in Henan Province, PRC, was jointly funded by the World Bank and the Central Government. It is quoted by the Chinese Government as a demonstration project for international project management of Sino-foreign joint ventures. The project, chosen as pilot study, will be further explained in the later chapters.

concerned, as a condition of providing loan to the Chinese government, the World Bank strongly suggests (WB, 1994):

- To establish a project management organisation which is able to raise funding and manage the project independently.

- To establish a management system which could be able to clarify the relationships of the rights and the responsibilities of the Client, Engineer and the Contractors.

- To make clear that the contracts could be awarded to the Sino-foreign joint venture contractors so as to create the best international practice and obtain technology transfer and exchange of technology.

3.5.3. Barriers to Technology Transfer

There appears to be more resistance to technology transfer in construction than in other industries. The barriers in transfer of construction technology as identified by Abbott (1985) include:

- Unwillingness of foreign firms to nurture potential competitors in a declining world market.

- Tendency of technology transfer to add a time and cost element (and managerial complexity) to the already difficult and risky business of contracting.

- The usual lack of understanding (among foreign enterprises, local beneficiaries and clients) of what is to be transferred.

- Suspicion of the recipient and the client about usefulness of what is being transferred.

- Ineffectiveness of previous transfer, as the trained personnel seldom utilise what they learn.

3.6. The Current Situation of Technology Transfer in China

Before economic reform, construction industry and other industries in China were arranged in a 'block' format (Flanagan and Li, 1997), where they each had the same factories making the same products for the customers with the same demands. The reform from the central planned economy to the market economy saw the break down of these blocks and the Chinese firms were suddenly faced with international competition. They had to absorb technology that helps them survive. As a result, technology transfer has become very important and popular in China.

China's leader, Deng Xiaoping[2], has set targets to achieve a per capita income of US$4000 (presumably at 1987 prices) by 2049 - the Hundredth Anniversary of Communist rule - which would rank China among the medium-developed countries in the world. To achieve this will involve both the importation and absorption of foreign technology on an unprecedented scale.

3.6.1. Legal Status of Technology Transfer

Since economic reform started in 1978, international technology transfer in China has been developing quickly. At present, the priority of this work is to introduce new and advanced technology from developed countries and to export the advanced technology as well. In order to promote international technology transfer, several relevant laws and regulations have been worked out, such as, the Technology Contract Law of China adopted in 1987, the Science and Technology Improvement Law of China adopted in 1993, Science and Technology Result Transfer Law of China adopted in 1996 (Yu, 1991). It should be noticed that these policies have a profound influence on technology transfer in China. In addition, technology transfer has been one of the main Chinese objectives in attracting foreign investment.

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[2] **Deng Xiaoping** (1904-1997), Chinese Communist leader who served as the de facto ruler of China from 1976 to 1997. Under Deng, who survived two purges before he succeeded Mao Zedong, China developed into one of the fastest-growing economies in the world.

3.6.2. Encouragement of Technology Transfer

The Science and Technology Improvement Law of China encourages enterprises to carry out technological innovation and the renewal of equipment so as to increase the scientific and management competence. This law facilitates enterprises to develop new technology and to strengthen the competitive power in the market, in light with the demand of international and domestic market. Enterprises can import advanced technology and equipment from developed countries through technology consultation. Enterprises are encouraged to develop new products and high-technology products by applying new technology to participate in the competition in the international market and to promote the internationalisation of high-technology industry.

The improvement of science and technology in industry, communication, post and telecommunication, geological prospecting, construction and installation should be encouraged so as to increase the economic and social results.

3.7. Aspects of Technology Transfer in the Construction Industry in China

In the process of the internationalisation of the construction market in China, technology transfer is likely to be involved in the following respects in the construction industry in China:

1. Project Supervision (Project Management)

Since 1988, a supervision system has been introduced for the execution of large and middle-sized construction projects in the construction industry. A large number of construction supervision companies were established. Construction supervisors were trained so as to promote the construction supervision system. However, there still exist many problems in the process of the execution of project supervision. Supervisors need to be familiar with the international practices and to be trained to have a good command of the basic theory of project supervision. The means and methods need to be improved with wide application of computer technology and information technology. Therefore, there is a large potential for the western consultants to provide project supervision management services in the construction market in China.

2. Training Services

The project-client's-responsibility system was adopted from 1992. Since then, middle and large-sized projects must have a client who is responsible for the execution of the project from the beginning to the end so as to ensure a good investment and economic return will be achieved. To do the work well still needs a large quantity of experienced personnel. There are training co-operation programmes between the EU and China. The China-Europe International Business School has already been established in Shanghai, to develop co-operation complementary to the efforts made by Member States in higher education and vocational training.

3. Joint-venture Operation

In the construction market in China, construction activities can be organised in collaboration with a foreign construction contractor, with whom the Chinese construction contractor enters into an agreement. Generally, this option is allowed when advanced technology and management skills are required for major complex foreign investment projects.

4. Consulting Services

Foreign consulting companies are invited to provide consulting services on the projects with foreign aid. In the preliminary stage of Xiaolangdi Hydro-electric Network, for example, a contract was awarded to a leading Canadian consulting company for the consulting services of feasibility study.

5. High and New Technology Based Projects

Foreign general contractors have been independently employed in China frequently on "high tech" turnkey projects. The joint venture investment project of China World Trade Centre in Beijing was signed in 1986. The project is a US$ 231 million hotel, office and apartment complex. The contract for the first two phases of the project was awarded to a leading French general contractor, Societe Auxiliare d'Entreprises (SAE). One of the main obligations of the contractor was to employ Chinese workers and provide technical training to the Chinese specialist trade contractors.

6. Projects Financed by the World Bank

In most cases, the projects financed with a loan from the World Bank are promoted for international competitive bidding. The Xiaolangdi Hydro-electric Network, the largest construction project financed in China with loans from the World Bank, is a model project of the World Bank and the Chinese government. The contract value of the first phase of the project is about RMB 32 billion (about US$ 4 billion).

3.8. Summary

3.8.1. Technology Transfer: Problems and Solutions

It has been clear that confusions about technology transfer in the construction industry can be attributed not only to a misunderstanding of the concept, but also to the complexities of comprehending transferee's need and formulating programmes that effectively satisfy these needs. Therefore, satisfactory measures of ensuring technology transfer is still a hard task due to lack of appropriate data and the diversity as well as the complexity of the channels through which technology is transferred.

3.8.2. A Framework of Technology Transfer in Construction

Based on the review of the current literature of technology transfer in construction and the premises of technology transfer models, a framework of technology transfer in construction has been constructed. It should be pointed out that it is impossible that this framework will be applicable and functional to all related situations. However, the model presented here will provide insights into the key components of technology transfer in construction. The failure or success of technology transfer rests on the congruence of all the parties concerned. Furthermore, the responsibility for technology transfer should fall jointly on the funding agency, the transferor, and the transferee as well as the congruence among all the parties regarding the technology to be transferred as shown in Figure 3.3.

In this framework, a principle has been addressed that is predominantly important in the process of technology transfer in the construction industry, namely congruence among the transferor, transferee and the funding agency regarding the technology to be transferred. Among all the relevant parties, if a high degree of congruence does not exist, the technology will not be transferred effectively.It should be pointed out that there exists deference towards technology transfer between the public funded projects

and the private funded projects. Technology transfer is promoted in the projects funded by governmental agencies and developmental agencies such as the World Bank, Asian Development Bank. However, technology transfer seems not as important as public funded project as far as the private funded projects.

3.8.3. Current Issues of Technology Transfer in China

The construction industry in China still displays characteristics of its origin in a planned economy. However, its structure is not uniform and in fact presents quite a complex picture. There are state-owned units, nominally collective-owned units which are in fact also owned by the state and true collective-owned units run by rural construction teams. Overlaid upon these rather anachronist organisations, are new generations of construction companies, which can be wholly owned by Chinese, owned by a foreign organisation or joint-venture between the two. An irony of the situation is that the most traditional rural construction teams composed of peasants from agricultural production often out-perform more technically-superior companies. This is because significant inefficiencies have developed, where the industry has attempted to keep pace with the rapid economic expansion by transplanting new technology without the capacity to fully embrace it. It is this sector of the industry that is struggling to come to terms with technology, which will be the focus of this study.

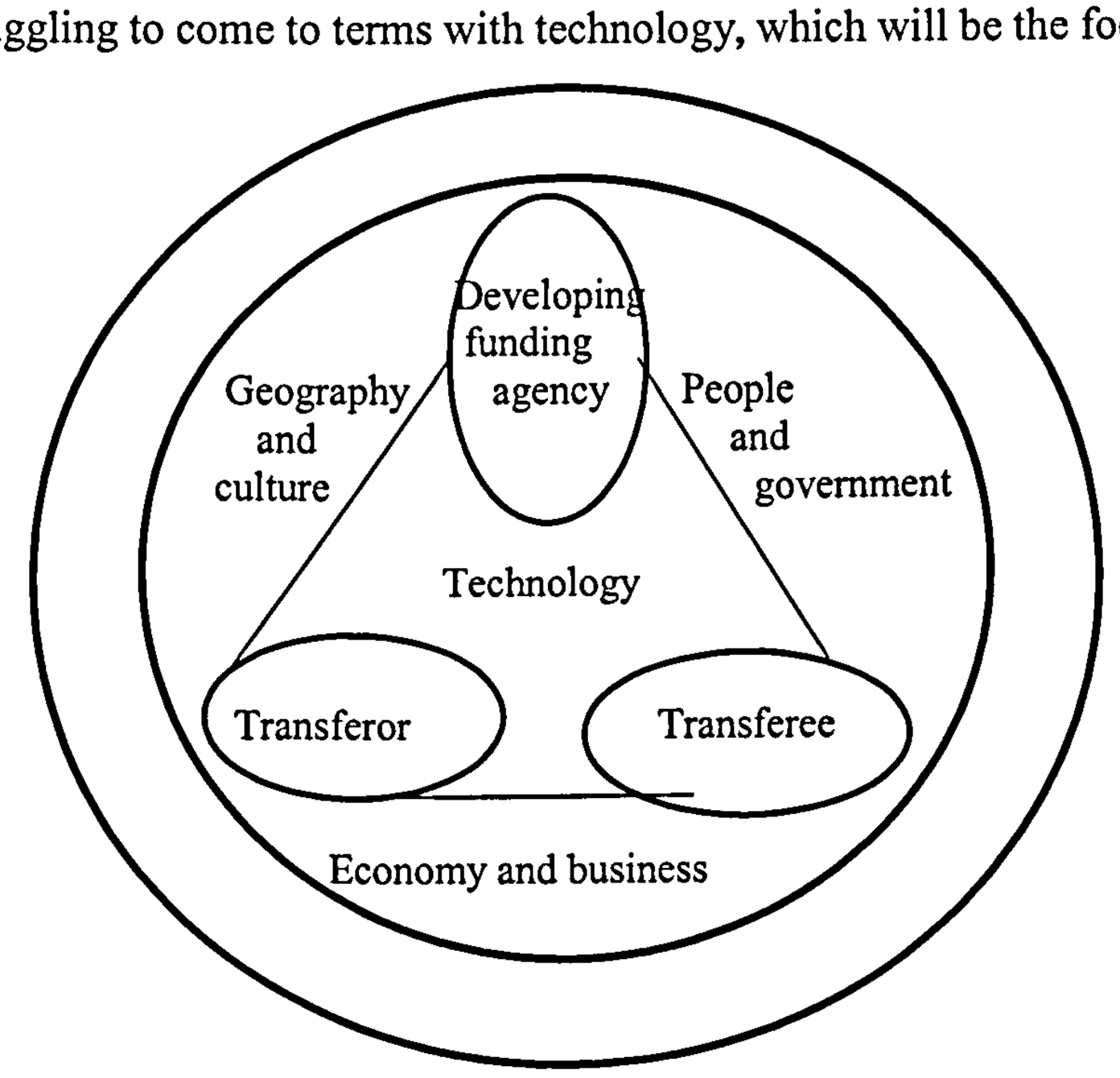

Figure 3.3. Technology transfer within good congruence

Chapter Four

Theory and Practice of Knowledge Transfer

4.1. Introduction

The review of the current literature of technology transfer suggests that technology transfer may be ineffective or subordinated by other issues of which knowledge transfer is the most significant as knowledge is the key to control over technology as a whole (Mnaas, 1990). A further examination of the current literature of technology transfer shows that interest in knowledge transfer is at present more popular than in technology transfer. Sometimes, technology transfer and knowledge transfer goes hand in hand. Sometimes, knowledge transfer occurs without technology transfer. In most of the cases, it is knowledge that flows between the transferor and the transferee. Without knowledge transfer, technology transfer does not work.

First of all, this chapter addresses issues of communication and knowledge transfer in construction industry, with particular reference to international joint venture projects. Based upon the survey of the literature of knowledge transfer, this chapter reports problems and practicalities of knowledge transfer with particular examination of various aspects of knowledge transfer in the process of problem-solving and decision-making within joint ventures projects. The strength of any project decision is based on the knowledge, expertise and project information that informs those making the decision. The potential for decision-making and problem-solving is held within the knowledge and expertise of the project team.

4.2. Communication and Knowledge Transfer

Communication is a relatively recent academic discipline, and organisational communication has been an important subject of that discipline since 1950. Because communication is acknowledged by academics and managers as a major push since 1970 to develop instruments helpful in analysing communication so that we can make interventions to achieve organisational effectiveness (Downs, 1994). Communication is a process involving the exchange of message and the creation of meaning, it requires that at least two people contribute to the ongoing and dynamic sequence of events in which each affects and affected by the other in a system of reciprocal determination

(Gudykunst, 1998; Hargie, 1994). Therefore, without effective communication, it would be impossible to achieve a successful knowledge transfer.

4.2.1. Communication Issues in Construction

Without delving into the intricacies of semantics and linguistics, it is clear that communications, even on the most fundamental level, poses certain issues. *A* sends a simple message to *B*. Did *B* understand *A*? If not, does *A* realise *B* misinterprets the message? How often does an individual, especially in non-verbal communication, read a message incorrectly?

No doubt the most efficient way to communicate information from one person to another is orally, face to face. As Austen and Neale (1995) point out that this form of communication is more efficient because it does not just rely on words: gestures, eye contact and other forms of non-verbal communication are used. Furthermore, the communication process relies on interaction between people. Other forms of informal communication include telephone conversations and hand-written notes, both of which are effective.

This is especially the case in construction. In construction, specifications are written in a logical, orderly manner to describe the quality of the workmanship, the quality of the material, and the descriptive features of the project. As a matter of fact, the specifications communicate those aspects of the job best described with words while the drawings communicate those aspects of physical details, locations and dimensions. Due to the technical sophistication of the message, communication in construction is seen as a sort of modern hieroglyphics like translating a foreign language (Melvin, 1979). However, construction management requires germane skills of communication that touches every one in diverse forms. Essentially, that is what construction management is all about: several groups communicating with each other in the joint venture teamwork of building a structure.

4.2.2. Knowledge Management in Construction

It is widely recognised that knowledge management is an important issue in construction industry. Literature suggests various definitions for knowledge management. However, Egbu (2000) defines knowledge management as:

> *"Knowledge management is about the process by which knowledge is created, acquired, communicated, shared, applied and effectively utilised and managed in order to meet existing and emerging needs, to identify and exploit existing and acquired knowledge assets".*

From an organisational perspective, effective knowledge management is about turning personal knowledge into corporate knowledge that can be widely shared and properly applied throughout the organisation in such a way as to create competitive advantage to the organisation.

It is regarded as a subject that suggests that what we have in our minds, such as intellectual capital, intellectual property, experience, knowledge and information, is our primary commercial resource (Steward, 1998). Frappaolo & Toms (1997) define knowledge management as a tool-set for the automation of deductive or inherent relationships between information objects, users and processes while Takeuchi (1998) believes that knowledge management is about capturing knowledge gained by individuals and spreading it to others in the organisation. However, the development of knowledge management as a discipline gives us the opportunity to model the dynamic interpersonal process of knowledge transfer. Furthermore, such discussion can help increase the profile of "people-centred" strategic thinking.

Egbu (2000) argues that lower costs and higher productivity are no longer seen as key influences on long term corporate competitiveness. There is no doubt that to a great extent they ensure survival but not growth. The ever-changing markets and the nature of competition also demand accelerated innovation and knowledge creation supported by the dynamic core capabilities of organisations. There is an increasing acceptance

that the economic and producing power of a modern organisation relies more on its intellectual and service capability than in its hard assets, such as land, plant and equipment. Effective knowledge management is seen as offering market leverage and competitive advantage to organisations.

Knowledge management is a complex social process. Egbu (2000) further argues that knowledge management is ten percent (10%) technology and ninety percent (90%) people issues. Knowledge management is sophisticated not only because of its potential for organisational value but also because of the solutions and technologies that can be applied to it. It is the role of knowledge management, therefore, to connect two nodes, knowledge owners and knowledge seekers. The knowledge of one is transferred to the mind of another, so that a new decision can be made or situation handled.

4.2.3. Explicit Knowledge and Tacit Knowledge

Knowledge is increasingly being recognised as a vital organisational resource that gives market leverage and competitive advantage (Nonaka and Taekuchi, 1995, Leonard-Barton, 1995). Knowledge consists of truth, beliefs, perspectives, concepts, judgements, expectations, methodologies and know-how, and exists in different forms such as tacit, explicit, symbolic, embodied, embrained and encultured knowledge. In particular, knowledge has become a substance to be "managed" at its most literal sense. Polanyi (1967) considered human knowledge by starting from the fact that *we know more than we can tell.* In general, knowledge consists of two components, namely explicit and tacit. Technical knowledge consists of these two components – 'explicit' and 'tacit', however, the greater the extent to which a technology exists in the form of the softer, less physical resources, the greater the proportion of tacit knowledge it contains. Tacit knowledge, due to its non-codifiable nature has to be transferred through 'intimate human interactions' (Tsang, 1997).

4.2.4. Features of Explicit and Tacit Knowledge

Nonaka and Takeuchi (1995) describe some distinctions between tacit and explicit knowledge, which are shown in Table 4.1. Features generally associated with the more tacit aspects of knowledge are shown on the left, while the corresponding qualities related to explicit knowledge are shown on the right. Knowledge of experience tends to

be tacit, physical, and subjective, while knowledge of rationality tends to be explicit, metaphysical, and objective. Tacit knowledge is created "here and now" in a specific, practical context, while explicit knowledge is about past events or objects "there and then". Table 4.1 shows the features of explicit knowledge and tacit knowledge.

Tacit Knowledge (Subjective)	**Explicit Knowledge** (Objective)
Knowledge of experience (body)	**Knowledge of rationality** (mind)
Simultaneous knowledge (here and now)	**Sequential knowledge** (there and then)
Analogy knowledge (practice)	**Digital knowledge** (theory)

Table 4.1. Features of Tacit Knowledge and Explicit Knowledge (Nonaka and Takeuchi,1995)

4.2.5. Model of Codification of Knowledge

Skyrme (1999) models the packaging and commercialising knowledge, which shows some form of codification from tacit knowledge to knowledge in more explicit forms. What starts as un-codified knowledge, often a set of ideas, is gradually shaped through interaction and expression into something more tangible, such as a process description, a product design or specification, which finally emerges as products for market. Figure 4.1 represents the model of codification of knowledge.

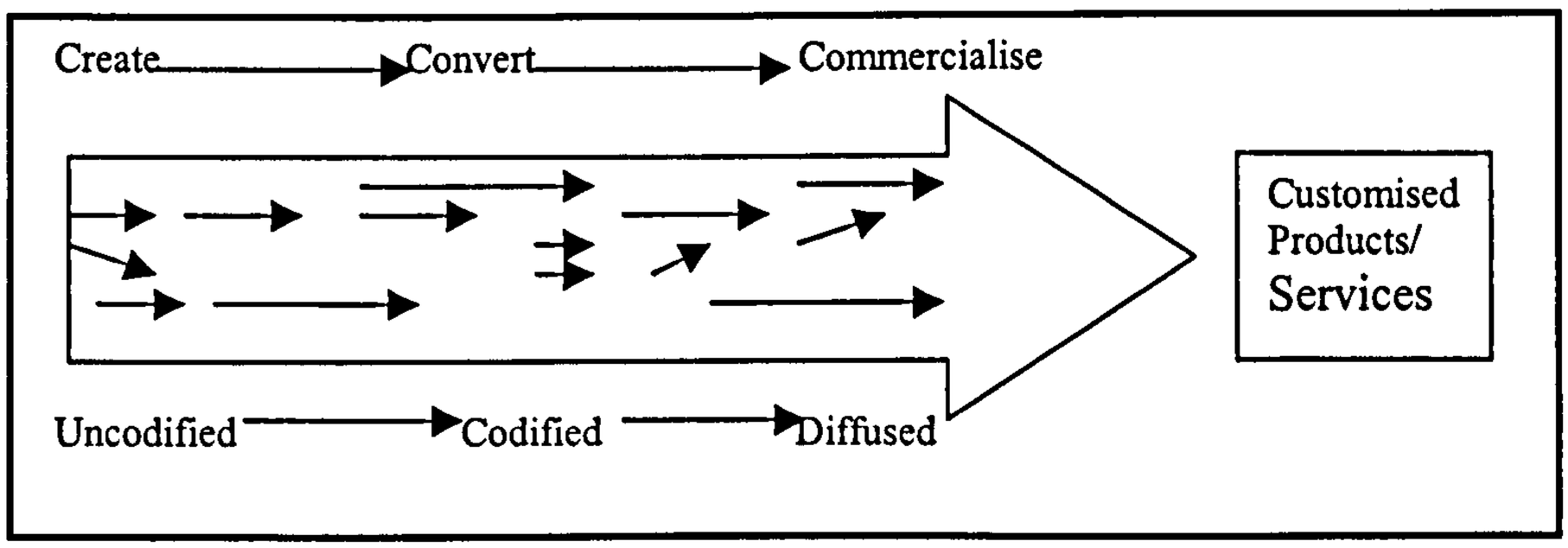

Figure 4.1. Codification of Knowledge (Skyrme, 1999)

4.2.6. Knowledge Transfer

Knowledge transfer is about connection not collection, and that connection ultimately depends on choice made by individuals (Dougherty, 1999). It is worth noting that this

form of transfer in particular may well be a 'two-way process' between the transferor and the transferee.

Knowledge transfer is also an increasingly popular term in the literature as writers attempt to highlight the human aspect of knowledge management. There is often a distinction made between knowledge transfer that occurs naturally or informally, and that which takes place in more formalised routines.

This natural transfer, or unstructured exchanges and informal exchanges, are vital to a firm's success. However, one of the essential elements of knowledge management and knowledge transfer is to develop special strategies to encourage such spontaneous exchanges of knowledge (Davenport and Prusak, 1998). It is of great significance for an organisation to be able to capture and use the knowledge inside managers' heads. Maitland (1999) argues that the crucial factor in determining a company's competitive advantage is its ability to convert tacit knowledge into explicit knowledge through organisational learning. That is why some companies encourage friendly networking and the release of tacit knowledge by setting up individual intranet sites where staff can post information about themselves.

4.3. Problems and Practicalities in Knowledge Transfer

This section addresses a range of issues of knowledge transfer, such as, the success, barriers, motivations and mechanisms of knowledge transfer.

4.3.1. Success of Knowledge Transfer

People's natural tendency is to try to transplant the work in their home culture into a new culture. To the surprise of most people, these "tried and tested" skills will not work, resulting in destabilisation, culture shock and intolerance towards others (Berger, 1998). It is necessary to understand the basic tenet of good cross-cultural relationships, otherwise, misunderstanding may escalate and barriers to communication may be erected.

The significance of global thinking has been widely promoted over the past five to ten years, yet it has not impacted on the learning of managerial skills. Cultural awareness

and country briefings has been highly evaluated in the staff development plan of many enterprises. However, what is needed is a more integrated approach blending skills to recognise the cultural context when planning a strategy to build effective relationships and systems. There is no magic for people to develop in terms of cross-cultural skills. However, Berger (1998) has listed the following skills:

1. Communication

Communication is a process by which people verbalise their feelings, express their opinions, convey their ideas, influence others and transmit knowledge. Without communication civilisation would spin into a spiral of confusion and chaos. Communication skills include:

- Gauging one's level of jargon and speed of delivery to the language fluency of the listener;
- Recognising the differing cultural meanings of verbal and non-verbal behaviour;
- Listening and questioning to understand the views and opinions of others;
- Awareness of what is expected at the initial stage of building a relationship in order to build sufficient trust to work together productively.

2. Behavioural Expectation

Behavioural Expectation includes:

- Alertness to how people expect to behave at meetings, including preparation and agenda management;
- Awareness of a style of leading, negotiating and breaking deadlocks which is appropriate to a given culture;
- Recognition of how decisions are taken by another culture and the implication for time management and how decisions are taken.

3. Cultural Value

Based upon his survey, Hofstede (1993) concludes:

- Knowing which cultural values are most likely to impact on business, for example, leadership and decision-making style, importance of structure, individualistic compared to collectivist style of relationships and the importance of time;
- Preparedness to adopt to cultures whose values are different from one's own.

4. Cross-Culture Team Building

Learning is defined as the process by which one acquires new information, habits, and abilities. Some psychologists define learning as the essentially permanent modification of behaviour that originates from human interaction with surroundings. Learning networks are used to bring people together from different background to exchange practical ideas which may eventually result in innovative practices in companies (Kululanga, 1997). Transfer of knowledge and skills is an act of power, a claim on time and resources that was considered to be a natural part of organisational order (Darrah, 1995). Joint ventures between multi-national and local contractors are widely recognised as a means of enhancing local expertise (Glass and Saggi, 1999). As a matter of fact, joint ventures in construction involve even more intimate human interaction between partners, which makes more critical the issues of cross - cultural team building in the process of interaction of both foreign and local partners.

4.3.2. Exchange of Information and Knowledge

A problem with business communication is that people cannot be forced to provide or accept knowledge. The project environment is often complex, with complexity increasing with the number of specialists involved. For examples, project participants will determine how much effort they are going to expend assisting the processing of information. The individual may be selective with the amount of information disclosed, the person to whom they disclose it and the degree to which they attempt to get the other person to understand. A project environment that facilitates the release and exchange of information needs to support individuals and groups and assist information flow (Egbu, *et al* 2000). Organisations and joint venture partners need to reduce barriers and support positive communication. Some of the barriers are obvious, but it is probably the less obvious ones that are most threatening to the management of knowledge.

4.3.3. Barriers in Joint Venture Organisations

With the information and knowledge that flow across international joint venture organisational boundaries, barriers to communication are often present in the multi-organisational projects (Egbu, *et al*, 2000). The interactions of the partners in the projects allow information to be shared. The project teams confer developing common goals, building and sharing information. The motivation is that both parties share a vision of a future where their co-operation will continue, and they are both interested in improving the quality of their relationship. Therefore, short-term one-off projects are often problematic.

The construction industry normally pulls together project teams for one-off and short-term projects. International joint ventures are, in particular, established for a specific project. Little effort is made to develop common objectives, little time is allowed to break down barriers and form strong relationships across which information can flow. Time is a precious resource and the parties see no advantage in building close relationships with companies with which they will probably have no dealings after completion of the current project. Therefore, under the commercial pressures of completing a project to time, quality and cost, it is not always feasible to undertake a formalised commitment to transfer knowledge.

4.3.4. Motivation for Knowledge Transfer

In any interaction people will have their personal objectives or needs, and these needs are likely to vary from situation to situation. The most common reason for people coming together and engaging in interpersonal behaviour is simply that they have to complete some specified task (Hayes, 1994). People working on the same service line will need to converse with each other to get their work done. Therefore, managers in the joint ventures have to involve significant amounts of social interaction and knowledge transfer not because they particularly want it to, but they have to: once social interaction does occur then other motivating factors will come into play (Garavan, 1997).

4.3.5. Mechanisms of Transferring Tacit Knowledge

When knowledge is tacit, its transfer is more difficulty to achieve and monitor. Transfer of tacit knowledge involves intimate human interaction between the transferor and the transferee. Mustapha (1998) argues that this is especially the case in the construction industry because the special nature of the industry makes its management more complicated. This type of knowledge is not amenable to systematic codification and could only be accessed and transferred through intimate social interactions (Kogut and Zander, 1992). Knowledge is utilised and transferred through intensive and extensive interaction between group members. Co-ordination is achieved through mutual adaptation among members with common knowledge and shared implicit coding schemes accumulated through group interactions. Knowledge is generated and stored almost organically in team relationships and the mode of co-ordination is human-network based (Lam, 1997).

Badaracco (1991) identified that there is an expectation that technological partnership and knowledge transfer would enable the partners to take advantage of the complementarities of each other's knowledge and expertise to achieve benefits and raise their competitiveness in the global market. Societal culture is important in affecting the efficacy of technology transfer (Koizumi, 1982; Samli, 1985 and Kedia and Bhagat, 1988). According to Hofstede (1980), and Hofstede and Bond (1988), the absorptive capacity of the recipient for technology transfer is influenced by five dimensions of culture (uncertainty of avoidance, individualism vs. collectivism, power distance, masculinity vs. femininity and Confucian dynamism). This is in particular the case in an environment of Confucius dynamics and culture.

4.3.6. Joint Venture – A Vehicle of Knowledge Transfer

Miller (1997) argues that joint ventures are an example of collaborative arrangements that can be turned into value-creating mechanisms to graft together competencies and value-creating disciplines of their partners. Joint ventures in construction involve fairly intimate human interaction between partners. Problem-solving is predicated on a particular way of making sense of the world (Athey, 1974; Robertshaw, Mecca, and Rerick, 1978; Vangundy, 1988). It frames situations as amenable to a rational process of resolution, one in which careful planning precedes action (Suchman, 1987). As Poon

and Price (1999) expected in their study, most of the decisions generally made were of technical and engineering (64.7 per cent) and financial (28.6 per cent) nature. Personnel decisions were relatively infrequent particularly at low levels. The professionals would need more time to deal more with financial problems while front line supervisors were mainly concentrated on technical and engineering matters. Important decision-making has to involve managers from both sides of joint venture partners.

4.4. Knowledge Management Programmes in Construction

Construction organisations need to recognise the importance of an active process management of knowledge creation, gathering, storing and exploitation. The culture and climate and the mechanisms in place should allow for the possibility for knowledge to be readily shared and transferred from project to project and across project teams (Egbu et al 1998b, 1998c). Regular meetings, in-house seminars and workshops interviewing, writing, video communication, de-briefing after end of projects, coaching and job rotation are the mechanisms which construction organisation can use for transferring knowledge across project team. Holland, (1999) suggests ten ways to embed knowledge management into organisational culture:

- Reward knowledge–sharing behaviour
- Define and communicate knowledge management behaviour
- Consider formal agreements on knowledge management for key positions
- Make knowledge management company policy
- Have managers systematically enforce and reinforce knowledge management
- Identify knowledge management positions
- Incentivise key knowledge management actions
- Explicitly manage knowledge management for each and every employee
- Publicly recognise good knowledge management
- Take action on poor knowledge management

For the development of knowledge management programmes in the construction organisation, based on the case study research projects funded by the Economic and Social Research Council (ESRC) and European Social Fund (ESF), Egbu (2000) has developed a framework for addressing knowledge management issues in construction,

where he considers five integrated dimensions in order to develop coherent knowledge management programmes. They are knowledge content, people, processes, technological infrastructure culture (leadership, strategy, motivation and communication).

- People. Ensuring that key personnel have access to know-how and best practices can enhance knowledge sharing. In addition, efficient and accurate mapping of knowledge can be accomplished with the help of people who informally act as the organisation's memory.

- Content. Defining the knowledge that is strategically relevant to the organisation (knowledge that meets the business needs of the organisation, now and in the future) should be seen as the first step in knowledge management implementation.

- Culture. The knowledge transfer media chosen by the organisation must be such that is appropriate to its culture.

- Process. An organisation should identify the knowledge, which it has after defining the knowledge it needs. If requisite knowledge is not available within the organisation, then this must be generated, perhaps by acquisition. The introduction of knowledge management needs to follow a logical sequence of tasks to minimise effort and cost.

- Infrastructure and technology. The infrastructure that is put in place to support knowledge management must be adapted to the organisation's needs and not the other way round. It must also specify updating responsibilities, data structure, access rights and security since knowledge gets old and can 'decline in value' over time.

4.5. Summary

Effective transfer of knowledge creates value for the construction organisation and their clients, and involves due consideration of the people, content, culture, process and

infrastructure dimensions. However, it is an arduous task to achieve because of the sophistication of knowledge creation and knowledge transfer. A further examination of the literature has revealed that there is very little empirical study directed towards knowledge transfer and knowledge management in construction. Therefore, there is ample scope for research in this important area.

Chapter Five

Methodological Issues

5.1. Introduction

The primary interest of the study is to identify how management know-how is transferred between foreign and local managers within international joint ventures. It is believed that the identification of this transfer process involves cross-cultural research. In order to have an extensive understanding of the foreign and local elements, therefore, the aspects of cross-cultural research have been examined with a review of creative problem-solving in the real life world. However, it is important to have process observation of knowledge transfer between foreign and local managers. It should be noted that these premises have directly contributed to the design of the study.

Furthermore, two concepts, internal and external validity, are fundamental and crucial to developing research designs (Vaus, 2001). Ideally research design should be both internally and externally valid. Therefore, the research project is composed of two major studies – the pilot study and the main study, both the pilot study and the main study are designed to be an integral part of the research. It has been recognised that the pilot study will certainly generate valuable results, which might be the causal conclusions. However, it is believed that the main study will generate result in a much wider context, which will sustain the external validity.

The measurement of the process of knowledge transfer between foreign and local managers involves the observation of human interaction, measurement of attitude and interests as well as motivation. Therefore, psychological instruments and methodology have been approached, as psychology is defined as the scientific study of the human behaviour and the process of human thinking. Furthermore, based on a series of inventories (Melvin, 1979; Lee, 1990; Gatchel and Mears, 1982; Cohen, Swerdlik and Phillips, 1996) that measure intelligence, personality, interest, preference and decision-making, the thought of designing an assessment inventory for the current study has formed into shape. Therefore, a psychological instrument-assessment inventory has been designed and introduced into the study.

First of all, the chapter examines the design concepts and philosophical notions of the study, which are essential because they would provide guidance for the design and conducting the research. Then the chapter examines methodologies that have been used both in the Pilot Study and in the Main Study. Furthermore, the chapter explains the data collection process in each step of the study.

5.2. Design Concepts and Philosophical Notions of the Study

According to Tashakkori (1998), there are two schools in the field of social and behavioural science, which are represented by positivist/empiricist and constructivist/phenomenological orientation. The positivist paradigm underlines what is called quantitative methods for explanatory research while the constructivist paradigm emphasises qualitative methods for exploratory research.

It has been recognized that academic debates raged in the social and behavioral sciences regarding the superiority of one or the other of the two major social sciences paradigms or models between positivist and constructivist. However, in most cases, the researchers incline to the view point of pacifists, who appear to present the compatibility thesis based on a different paradigm, which has been referred as pragmatism. In order to minimize discrepancies between the data collected during the study and the phenomenon of the real world, the current research project has adopted a mixed methodology that combines both qualitative and quantitative approaches. As the research topic implies, the current research project is deemed to be cross-cultural research which involves unearthing the process of creative problem solving in the real world with particular reference to tracking the transfer process of tacit knowledge between foreign and local managers. Therefore, an extensive understanding and clarification of the basic elements and the implications of the following issues are essential and crucial.

5.2.1. Cross - Cultural Research

Cross-cultural research has both theoretical and practical advantages. Goodwin (1996) crystallises the complexities and the significance of cross-cultural research. He points out:

> *"[...] more recent concerns* (about methodology and ethics, generalisability and relevance of much psychological work) *have*

stimulated a resurgence of interest in the universality of psychological theories and consequently in cross-cultural variation in both the content and the processes of human interaction".

Cross-cultural research is important because it can serve a number of purposes. After examining the current literatures, Goodwin (1996) summarises four points:

- It can help address important issues concerning the way in which individual personality factors interact with wider societal forces;
- It can be used to test apparently 'universal' and competing theories under particularly stringent conditions-those where there is considerable cultural variation;
- It allows people to learn directly from other cultures, particularly where undesirable social activities (such as relationship violence);
- The acculturation processes in new or changing societies have important implications for a range of social behaviours.

Despite the advantages and increasing interest of cross-cultural generality, cross-cultural psychology research is still predominantly un-theoretical and unsystematic. However, Goodwin proposes (1996) a five-stage guideline for conducting cross-cultural research:

1. Generation of Central Research Questions

The norm of this step is to use geographical units as the basis. It is an interesting challenge to define exactly which topics are suitable for study across the cultures of interest. The most valuable psychological work is likely to involve hypotheses, which specify some form of relationship between broad social structural variables (e.g. socio-economic status), and individual behaviour, cognition or effect. Therefore, the researcher might turn to one or more of the systems of cultural variations which act as mediating predictors for the interaction of societal influence and individual behaviour.

2. Ensuring Suitable Questions

An important approach to this point is to allow the participants in the country under investigation to become an active participant in the research, in order to verify the appropriateness of the questions being posed. It should be noted that one important issue is the translation of the questions in conducting cross-cultural research. There is a variety of degrees of translation, ranging from broad pragmatic translations to more specific interpretations.

3. Piloting the Research Question

This can be a relatively short procedure, but it is nevertheless essential. It is a good idea at this stage to attempt to assess some of the situational/ideological factors that might affect the distribution of the inventories or running the experiment. It is necessary to ask the pilot participants to write down, anonymously and as honestly as possible, what was going through their minds.

4. The Actual Collection of Data

A general rule for cross-cultural research is the notion that research should be multi-method wherever possible. It is necessary to look at the actual background of participants, and try to clearly specify the boundaries of their defined participant group. As culture is such a complex phenomenon (and cultural differences are so easily misinterpreted) that this guidance may be particularly pertinent to cross-cultural research.

5. Writing Up and Discussion of Findings

The main message from Goodwin (1996) is that honesty is essential in writing up cross-cultural work.

5.2.2. Creative Problem-Solving in the Field

From the street corners of the North End of Boston[1] to the Basque Region of Spain[2], William Foote Whyte has been a pioneer in developing method and theory

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[1] ***Street Corner Society***, published by William Foote Whyte, in its four editions from 1943 to 1993, has sold 265,000 copies. It is the best-selling book in sociology published before 1950-excluding textbooks and classics such as Max Weber, Emile Durkheim, and Karl Marx.

that have changed and expanded the way that people look at social structures and the individuals within them.

1. Four-Step-Methodology of Conducting Action Research

With a summary of his research experience in the field, Whyte (1997) produces a list of necessary steps of conducting action research in the field as follows:

- Gaining Access to the Field
- Systematising Participant Observation
- Interviewing in the Field
- Facts, Interpretation, and Ethics in Qualitative Inquiry

According to Whyte, his own theoretical ideas have arisen largely out of his fieldwork and his field experiences have led him to develop theoretical ideas, while his field experience has suggested new approaches to research methods. The above steps that he summarised are very important and practical steps in dealing with participant observation.

2. Gaining Access to the Field

Before the researcher can decide what and how to observe, the researcher has to find way into the organisation or community. The researcher must prepare a good reason or purpose of study to the people whom he is going to study. If the researcher cannot be accepted as a proper person, then nothing could make the study acceptable. It is important to make it clear that the researcher is not trying to pass judgement on the people the researcher meets. The researcher is trying to understand them in their own terms. In other words, the researcher needs to be accepted as a friend. As they are willing to accept the researcher, then the researcher can assess what they expect from friends and to what extent the researcher can meet their expectations.

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[2] ***Making Mondragon***: The Growth and Dynamics of the Worker Co-operative Complex (jointly authorised by Kathleen King Whyte) is widely regarded by students of co-operative movement as the best book yet written on the Basque co-operatives of Mondragon.

3. Participant Observation

Whyte (1997) argues that participant observation should not be a set of random activities. The researcher must try to go beyond personal impressions to systematise observations with an aim to establish patterns of interactions and activities so that others can check and build on. That takes a great deal of patience and a small amount of resourcefulness. However, if the field workers keep looking for opportunities, they will eventually manifest themselves.

4. Interviewing in the Field

Interviewing should be seen as part of the whole fieldwork process, rather than an isolated exercise. The participant observer should undertake interview informally, simply listening to what people are saying and sometimes asking them to explain how they feel about the situation they are describing. The interview generally should fellow certain guidelines: not argue with the informant, not to express disapproval of him or her, and not to interrupt the statement made.

5. Facts, Interpretation, and Ethics in Qualitative Inquiry

Whyte (1997) argues that there are such things as social and physical facts. He insists that the researcher must begin by getting those facts straight. How the researcher interprets the behaviour of those observed and studied in relation to those facts is certainly subject to argument.

6. Transactional Relationships

Whyte (1997) further argues that as there is a limit to the number of interpersonal reciprocities (which he calls them *positive exchange* and *negative exchange*) that any individual can maintain. There must be other forces shaping human relations beyond interpersonal reciprocity. In the early 1950s Whyte's field experience led him to the framework of his theory of *Transactional Relationships*, which focuses on the way relationships yield benefits or penalties to the interacting parties. Based on the transactional relationships, he was trying to discover relationships between interactions, and activities, and inter-action sentiments or attitudes. In his typology, he referred them as seven transactional relationships as follows:

A. *Positive exchange*. This means the exchange of favours.

B. *Trading*. This means the buy and sell relationship.

C. *Competition*. This means that the individuals or groups are competing with each other to gain some financial awards. In this situation, co-operation can pay off.

D. *Negative*. In this situation, individuals or groups become involved in a tit-for-tat contest.

E. *Open conflict*. In this situation both individuals, or groups, openly acknowledge that they are trying to damage each other.

F. *Authority*. The person in authority agrees to pay other people specified amounts to do work.

G. *Joint-payoff*. In this type, two or more individuals or groups agree to pool some of the resources in order to gain resources from the environment. Joint-payoff is the basis of organisation in partnerships in business and the professions and is one of the guiding principles of work co-operatives. It also frequently occurs in informal collaborative relations between individuals or groups. It is frequently accompanied by positive exchange.

It should be pointed out that the six steps of conducting action research are important for the current research project because they give clear guidance for undertaking the field work.

5.2.3. Process Observation and Process Measurement

Holt (1997) explains that:

> *"Any hypothesised alternative or improvement to existing practice or knowledge, cannot be properly considered, until the existing conditions and problems surrounding it, are fully understood. Much of this understanding will emanate from the literature search, but this in isolation will rarely suffice. A first and most simple complement to the literature search is observation. Observation alone may be considered as a qualitative methodology, yielding some understanding of the way a process or condition is conducted, or exist at present. In this context, process observation is most often recorded as a narrative (vis-a-vis numeric data)".*

Holt (1997) further points out:

> *"[...] process measurement in this context could involve time study; this being the recording of times taken to perform a task, so that an output standard may be established". [...], many aspects of built environment research utilise questionnaire surveys. The most straightforward of these is the open question survey, which employs a questionnaire inviting any written reply to the question set".*

The primary interest of the current research is to investigate the current mechanisms of technology transfer and the aspects of technology transfer between foreign and local partners within international joint ventures in China. Furthermore, the research aims to investigate in particular the process of knowledge transfer. Therefore, much enlightenment of the philosophical thought in the design of research methodology of the current research has been drawn upon the above literature. With consideration of the paradigms and politics of the current research project, Process Observation and Process Measurement has been regarded as critical issues during the whole process of the research.

5.2.4. Structure of the Current Research Project

Given the design concept of the research, the structure of the current research has come into shape. *Firstly*, a literature review of the current state of technology transfer has developed the theoretical framework for the study. Moreover, a review of the literature in knowledge management and knowledge transfer has provided a further and an extensive understanding of the research problems and contemporary phenomenon of knowledge transfer, in particular, the mechanisms and process of both explicit and tacit knowledge transfer. *Secondly*, the pilot study has bridged the theoretical review of literature in the academic world and the practical approach of the knowledge transfer phenomenon in the real construction site, which has built a platform for the in-depth understanding of research problems and undertaking the main study. *And thirdly*, by using an assessment inventory, data have been collected and a theoretical model has been constructed in the studies. Table 5.1 represents the structure of the current research project.

Phase	Programmes	Academic Activities	Methodology Employed
Phase one	Literature Review	• Current state of knowledge • Technology Transfer • Internationalisation • Construction industry in China • Knowledge management • Knowledge transfer 1. Explicit knowledge 2. Tacit knowledge	Research notes Keeping diaries Keeping on reading Keeping on writing
Phase two	Pilot Study	Case Study in Xiaolangdi • 6 study trips to Xiaolangdi Project • 1 knowledge transfer seminar • 25 interviewees • 52 copies of assessment inventories • Demonstration and presentation • Analysis and discussion • Feedback and modification • Validation • Contribution to knowledge	• Survey • Interview 1. Semi-structured interview 2. Structured interview 3. Assessment inventory
Phase three	Main Study	Main Study in Jiangsu, Henan and Xinjiang, PRC • Visit of construction authorities of Henan and Jiangsu, PRC • 450 copies of assessment inventories from Henan, Jiangsu and Xinjiang, PRC • Demonstration and presentation • Analysis and discussion • Feedback and modification • Validation • Contribution to knowledge	• Structured survey • Assessment inventory

Table 5.1. Structure of the Current Research Project

5.3. Mixed Method in the Studies

In general there are several styles of research, such as action research, ethnographic, surveys, case study and experimental. The nature of the present research programme has resulted in the adoption of mixed model studies. From a pragmatist point of view, a pilot study and a main study have been systematically designed in accordance with the special features of the study. As defined by Tashakkori (1998), a mixed methodology (or mixed methods or methodological mixes) contains elements of both the qualitative and quantitative approaches into the research methodology of a single study or multi-phased study. Tashakkori (1998) further defines the mixed model studies:

> *"As studies that are products of pragmatist paradigm and that combine the qualitative and quantitative approaches within different phases of the research process. There may be single applications within phases of the study, such as a quantitative (experimental) design, followed by qualitative data collection, followed by quantitative analysis after the data are converted".*

The qualitative data were intended to be collected through interviews during the pilot study. However, quantitative data were collected by having a structured survey in the main study followed by the quantitative analysis of copies assessment inventories.

5.3.1. Pilot Study

A pilot study is a trial run of the study that should be conducted on a smaller sample than that which will be used in the final version of the study (Carter, 1997). The purpose of the pilot study is to check whether the basic aspects of the design and the procedure work are suitable and appropriate.

However, the current research of the pilot study adopted the application of a mixed methodology that integrates both case study and interviews. The latter requires the researcher to have a good understanding of construction processes in order to identify and evaluate problems and potential solutions, while a case study involves

in-depth study of particular instances within the research subject (Fellows, 1997). According to Holt, (1997) interviews are best recorded for later typing-up of transcripts where necessary and to facilitate analysis. Therefore, both semi-structured and structured interviews were designed to be an integral part of methodology of the research during the pilot study phase. In addition, process observation and review of archival materials (such as method statement, work dairies, minutes of meetings) were arranged. Based on the assessment inventory, by using semi-structured interviews and structured interviews of foreign and local managers in the pilot study, data were collected for the design and formulation of the research model.

5.3.1.1. Assessment Inventory

Melvin (1979) defines psychology as the study of behaviour. He points out that:

> *"It investigates behaviour, stripping away the veneer of myth and irrational beliefs, so that one may more realistically comprehend why people act in certain ways. [...], Granted that psychology lacks the precision of physics, but it certainly exceeds the accuracy and perception of a rigid personality cemented together with prejudgement and prejudice"*

Psychologists, aided by concepts of applied statistics, in addressing human relations in construction management, are much more restrictive and precise in their terminology and measurements (Melvin, 1979). In psychological fields, researchers used personality inventories to assess/measure normal traits of people, such as sociability, emotional stability, the need to achieve, and a number of others. The notable personality inventories to measure interests, values and attitudes of human being are:

- The Strong-Compbell Interest Inventory;
- The Kuder Preference Record-Vocational;
- The Harrington/O'Shea System for Career Decision-Making.

In addition to the terminology and measurement addressed by psychologists, Whyte (1997) points out that for studies of attitudes and interest of people in an organisation or community, the questionnaire survey along with interview is the appropriate instrument. For the field interview, the researchers are only interested in how the person's experience led him or her to form the attitudes in question. In consideration of the validity and reliability of the methodology used, it has to be pointed out that the questionnaire survey has been modified into a structured survey with assessment inventory. Much of the design concept of assessment inventory for the current research project has been derived from the personality inventories that were designed by psychologists. The employment of the assessment inventories approach based on psychological paradigm is a trial run in the construction management research in a way in which it might be regarded as an extensive justification to the traditional research approach-questionnaire approach, which has been widely and repeatedly used by researchers.

5.3.1.2. Case Study

Yin (1994) argues that case studies are used extensively in social science research-including the traditional disciplines (psychology, sociology, political science, anthropology, history and economics) as well as practice-oriented fields such as urban planning, public administration, public policy, management science, social work, and education. The method also is a frequent mode of thesis and dissertation research in all of these disciplines and fields. Moreover, case studies (Melvin, 1979), which offers a wealth of important information, are increasingly commonplace even in evaluation research. Hypotheses can be developed by comparing information and data collected through case studies.

In general, case studies are the preferred strategy when "what", or "how", or "why" questions are being posed, when the investigator has little control over events and when the focus is on contemporary phenomenon within some real-life context. Case study relies on many of the same techniques as a history, but it adds two sources of evidence not usually included in the historian's repertoire: direct observation and systematic interviewing. The unique strength of case study is its ability to deal with a full variety of evidence-documents, artifacts, interviews, and observations.

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study inquiry:

- copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result;
- relies on multiple sources of evidence, with data needing to converge in a relevant fashion, and as another result;
- and benefits from the prior development of theoretical propositions to guide data collection and analysis.

Schramm (1971) further expounds:

> *"The essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they are implemented, and with what result".*

According to Yin (1994), case studies were appropriate for the exploratory phase of an investigation, and surveys and histories were appropriate for the descriptive phase, and the experiments were the only way of doing explanatory or causal inquiries.

5.3.1.3. Interviews

The interview is one of the most important sources of case study information. The interview may take several forms. Most commonly, case study interviews are of an open-ended nature, in which an investigator can ask key respondents for the facts of a matter as well as for the respondents' opinions about events.

Interviews are an essential source of case study evidence because most case studies are about human affairs. These human affairs should be reported and interpreted through the eyes of specific interviewees (Holt, 1997), and well-informed respondents can provide important insights into a situation. They also can provide shortcuts to the prior history of the situation, helping the investigator to identify

other relevant sources of evidence. However, the interviews should always be considered verbal reports only. As such, they are subject to the common problems of bias, poor recall, and poor or inaccurate articulation.

5.3.2. Main Study

It should be pointed that the main study is a continuation of the research project on the base of the pilot study. The case study with interviews proves appropriate and effective during the pilot study. The data collected are valuable for the building of the research model. Therefore, a structured survey with assessment inventory with modifications had been undertaken in the chosen sample places, which makes the context of the study much wider. Furthermore, what becomes more important is that the certain amount of assessment inventories will allow the researcher to have a quantitative analysis of the data.

In the consideration of the effectiveness and appropriateness of the methodology, the assessment inventory was repeatedly used in the main study. The difference between the pilot study and the main study are that the former focused on the collection of qualitative data through interview for internal validity while the latter concentrated on the collection of quantitative data for external validity through a structured survey.

5.3.2.1. Structured Survey

When a psychologist wishes to assess causes of behaviour without waiting for a result to occur naturally, or when the behaviour essentially precludes observation, he may elect for the structured survey method (Melvin, 1979). In doing so, the underlying reasons the behaviour might be directly inquired by asking questions. Therefore, considerable data can be accumulated in a relatively short time. Furthermore, surveys, which are under controlled and systematic circumstances, will provide surprisingly informative results (i.e., public opinions, election predications, consumer surveys). In fact, politicians and union officials often determine policies based on survey findings. Two major deficiencies may possibly occur in the survey method: (1) the subjects may willingly or unconsciously distort the true causes of their behaviour; and (2) a biased sample may result in an erroneous picture of the population segment that the investigator desires to study.

Therefore, for keeping the data as accurate as possible, a structured survey was carried out among the construction authorities and construction managers by delivering assessment inventories personally by the researcher during the main study.

5.3.2.2. Correlation of Responses with Levels of Economic Development

In the current study, the data from three different provinces in China were examined to see whether there is any association between the data gathered and the level of economic development of each province. The correlation technique employed is Pearson's Product-Moment Correlation Coefficient (Pearson's *r*). Karl Pearson was a pioneer of regression techniques and his *product-moment correlation coefficient* is today the most commonly used correlation technique.

Pearson's r is properly applied to data that are numerically discrete or continuous. By contrast, categorical data require other correlation techniques such as the *contingency coefficient*, and ranking scale data may be analysed using the *rank-order correlation* methods. Correlation concerns the relationship between variables; a correlation coefficient is a statistic used to express quantitatively the extent to which two variables are related (Lee, 1999). Examples of the use of Pearson's *r* are commonly found in the Construction Management literature. Examples include exploration of correlation between the comprise resolution styles and the satisfaction levels of contractors (Yu and Leung, 2001), and correlation between the value of Australia building completed and K value and B value (Mak, Ng, Chen and Varnam, 2000).

5.3.2.3. Method Statement in the Studies

In the construction industry, it has long been a common belief that the planning of construction methods is a subject that cannot be taught-only learned by experience. Such a situation was undoubtedly true when the importance of detailed planning of construction methods was recognised in the 50s. However, method statement is one of the most important documents in the planning process. Based on method statement the job was priced, cost breakdown of the tender sum was done, specialist staff for the supervision of subcontractors were arranged. The availability of work

study facilities to evaluate performance and provide recommendations for improvements in efficiency, and the use of program systems appropriate to the contract in question (Illingworth, 1998). Such systems will need to allow rapid assimilation of progress situations and provide weekly or short-term methods of giving easily understood communication to first line supervision.

There is little literature that touches the measurement of knowledge transfer. In fact it is hard to track the process of knowledge transfer, particularly the transfer of tacit knowledge in construction, because of the nature of tacit knowledge and the sophistication and the large dimension of the construction industry. It has been considered that the feasible way would be an attempt in focusing on a particular construction task so that the research problem may be approached. It is believed that it is a breakthrough to focus on tracking of the process of knowledge transfer when both foreign and local partners are dealing with method statement during the implementation of a project. What is important is that process of knowledge transfer in dealing with method statement will mirror the process of problem-solving and decision-making as well as the process of knowledge transfer in the whole industry.

5.4. Data Collection Process

According to Yin (1994), data collection for case studies can rely on six sources of evidence, such as documentation, archival records, interviews, direct observation, participant-observation, and physical artefacts.

The benefits of the six sources of evidence can be maximised if the investigator follows the three principles:

- Use multiple sources of evidence
- Create a case study database
- Maintain a chain of evidence

The data collection process for case studies is more complex than the processes used in other research strategies. The case study investigator must have a

methodological versatility not necessarily required for using other strategies and must follow certain formal procedures to ensure quality control during the data collection process. The principles are intended to make the process as explicit as possible, so that the final results - the data that have been collected - reflect a concern for constructive validity and for reliability, thereby becoming worthy of further analysis.

The first stage of data collection through interview in the pilot study was to produce a representation of the formal management structure of a typical joint venture project, which identifies the individuals, their roles in the management process and their company of origin (local and foreign). The second stage was to identify how the management structure requires these managers to interact. The third stage was to formulate a basic research model of knowledge transfer.

Holt (1997) suggests that structured survey is a very effective means of performing quantitative research. Therefore, further investigation of the main study adopted a fully structured survey requiring the respondents (managers in construction joint ventures) to complete a multi-sectional assessment inventory. The assessment inventories were developed on the base of the pilot study and joint venture data. Figure 5.1 shows a diagrammatic presentation of the data collection process for the research programme.

An in-depth investigation of dyadic interaction was undertaken in terms of:

- Analyses of dyadic communication/interaction
- Form and content of dyadic communication/interaction
- Purpose of dyadic communication/interaction
- Success of dyadic relationship in functional management terms

Based on the analysis of both the quantitative and qualitative data, a more refined analytical model of the transfer process of tacit knowledge had been constructed.

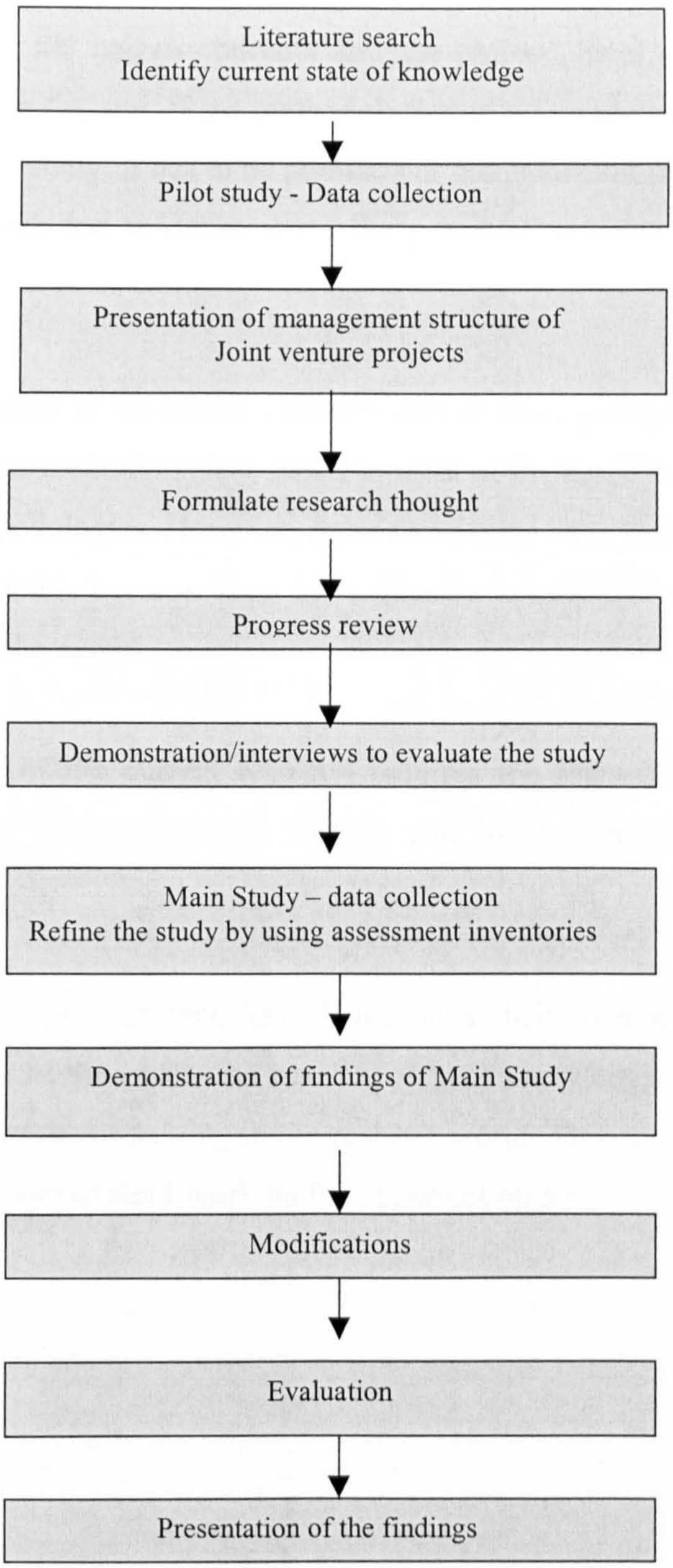


Figure 5.1. A diagrammatic presentation of the data collection process for the research programme

5.5. Summary

This chapter explicates the design concepts and the philosophical notion of the practice of the current study, and of the methodologies to be employed both in the pilot study and the main study. It has to be pointed out that whatever methodologies employed in the research has to demonstrate the potential to solve the research problems.

It has been recognised that cross-culture research and creative problem-solving in the field were not seen as methodological issues in most of the academic works that deal with research methodologies. However, these two issues have been covered in the methodological chapter, because they have directly contributed much to the design thought of current research.

- The special nature of the current research requires the identification of the knowledge transfer process between foreign and local elements, which is cross-cultural research;

- Both explicit knowledge and tacit knowledge have their own way of being transferred. In most of the cases, the transfer of tacit knowledge involves the process of creative problem-solving in the real life world. This research project involves a large amount of field-work on the construction site.

Chapter Six

Problem Area and Pilot Study

6.1. Introduction

First of all, based upon the current literature, the chapter presents a framework for knowledge transfer, where the problem area of knowledge transfer in the current practice has been identified. Therefore the pilot study is however to further define the problem area and seek solution. Following a brief introduction of Xiaolangdi Project in Henan Province, PRC, with a particular examination of why Xiaolangdi Project was chosen as the pilot study for the current research, the chapter reviews the whole arrangement of the pilot study with six study trips to China over two years. Furthermore, the chapter analyses and discusses the data collected during the pilot study. Finally the chapter presents the findings of the pilot study.

6.2. Problem Area: from Technology Transfer to Knowledge Transfer

Mnaas (1990) states that technology consists of four closely inter-linked elements: namely, technique, knowledge, organisation and product. However, knowledge contributes the major part to technology, which is the key to control over technology as a whole. Technical knowledge consists of two important components -"explicit" (codified in blueprints, designs, drawings and specifications) and "tacit" (kept in the human brain). The greater the extent to which a technology exists in the form of the softer, less physical resources, the greater the proportion of tacit knowledge it contains.

It is important that the understanding of explicit and tacit elements of knowledge will help identify the process of knowledge transfer. With regarding to the appropriateness and effectiveness of technology transfer, Samli (1985) models the pattern of technology transfer with consideration of six dimensions: geography, culture, economy, business, people and government (refer figure 2.2.). In addressing knowledge transfer issues in construction, Egbu (2000) develops a framework for managing knowledge, where he emphasises five dimensions, such as, people, content,

culture, process, infrastructure and technology (refer figure 4.2.). It should be noted that the above research work has provided wider understanding and significant insights towards the building an effective and applicable model of knowledge transfer. However, a framework for the establishment of effective knowledge transfer shown as figure 6.1 has been developed based upon the major contribution of the above research works. It should be pointed out that this framework combines both technology transfer and knowledge transfer, where the importance of tacit knowledge transfer has been established and the blockage of tacit knowledge transfer has been raised.

6.3. The Xiaolangdi Project

The Xiaolangdi Hydro-electric Network across the Yellow River in Henan Province, PRC was chosen as the pilot study, not only because it is one of the largest joint venture projects in China, jointly funded by the World Bank and the Central Government of PRC, but also because it is quoted by the Chinese government as a demonstration project for international project management of Sino-foreign joint ventures.

The Xiaolangdi Hydro-electric Network is located in the last gorge in the middle reach of the Yellow River, about 40 km north of Luoyang City, 130 km downstream of Sanmenxia Dam, and 128 km upstream of Huayuankou in Zhengzhou City. It is the only reservoir with a large storage capacity on the main stem of the Yellow River downstream of Sanmenxia.

The project consists of a dam, flood discharging structures and power facilities. The main objectives of the project are flood control, sediment control and water supply, irrigation, and power generation.

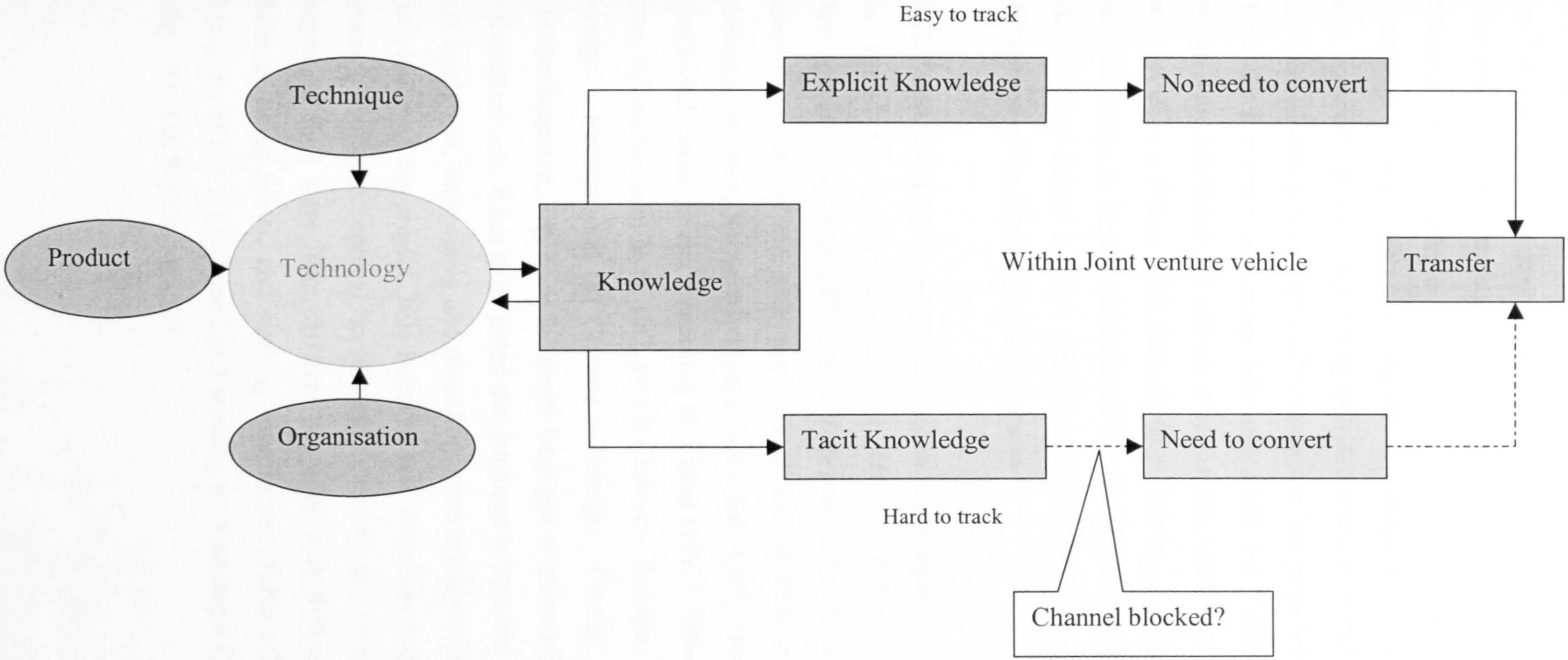


Figure 6.1 A framework for effective knowledge transfer

6.3.1. Major Joint Venture Companies

The Xiaolangdi Project was started in June 1994 and completed in September 2000. After international competitive bidding, three Sino-foreign joint venture construction companies won the project. The project was divided into three Lots, which were undertaken by three major joint ventures. The major local partners are the companies from Hydraulic-power Engineering Bureaux of the Hydraulic-power Ministry, PRC, while the foreign partners are multinationals mainly from France, Germany and Italy. There are a number of foreign sub-contractors and Chinese sub-contractors. The foreign sub-contractors are mainly from Europe, while the Chinese sub-contractors are from all over China. With their arrival at Xiaolangdi, they brought their engineers and technicians to Xiaolangdi from all over the world. However, most of the skilled and unskilled labour is local from Henan Province. Table 6.1 shows the relevant information of the three major joint ventures.

6.3.2. Statistics of Foreigners Working on Xiaolangdi

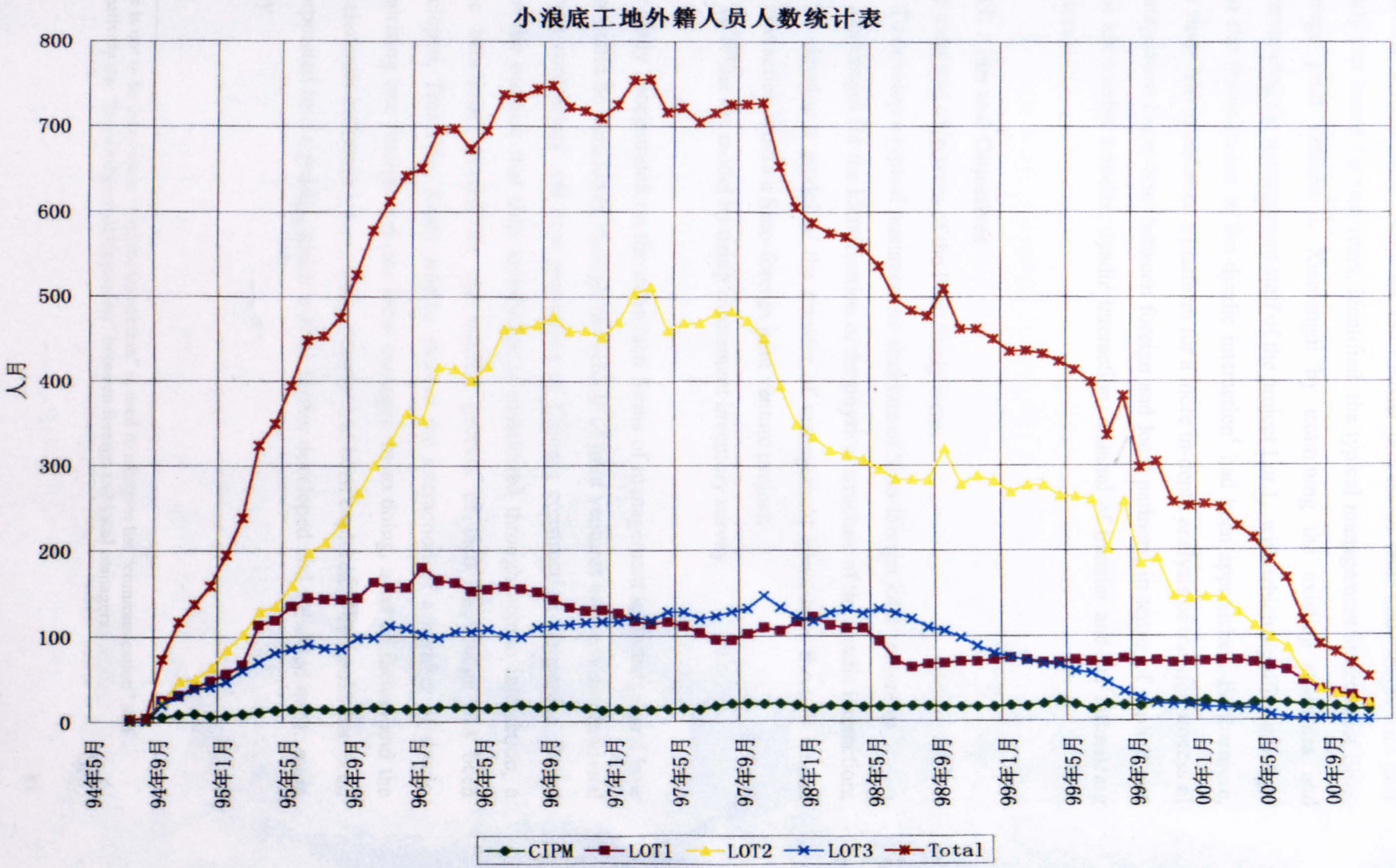
As confirmed by the International Office, Yellow River Hydraulic-power Development Corporation, PRC, there were more than 14, 000 people working on the construction site at the peak work, about 750 of them were foreigners from 51 countries, including Germany, France, Italy, UK, USA, Australia, Columbia, South Africa and Pakistan, etc. According to Zhang (1997), there are various patterns in terms of management style, such as: (1) Chinese – Foreign – Chinese; (2) Chinese – Foreign – Foreign; and (3) Chinese – Foreign – Foreign – Chinese. Besides the Chinese language, English is the major language of communication at the Xiaolangdi construction site. It has to be noted that language is a crucial barrier between Chinese and foreigners. Interpreters and translators were employed from the beginning to the completion of the project. It is believed that there was a grand scenario of culture diversity and philosophical sophistication among the people who worked on the project as they were from different countries with different cultural background, different living habits, and working experiences. Table 6.2 shows the statistics of foreigners of Lot 1, Lot 2 and Lot 3 working on Xiaolangdi Construction Site between May 1994 and September 2000.

Items	**Lot 1:** **Dam project**	**Lot 2:** **Flood discharge Engineering**	**Lot 3:** **Power generating system**
Joint ventures	Yellow River Contractor (YRC)	Sino-German-Italian Joint Venture (CGIC)	Xiaolangdi Joint Venture (XJV)
Major partner and its share	Impregilo S.P.A. (Italy) 36.5%	Zublin (German) 26%	Dumez (France) 44%
Partners and their share	- Hochtief A.G. (German) 36.5% - Italstrade S.P.A. (Italy) 14% - Hydraulic-power bureau No.14 (China) 13%	- Strabag (German) 18% - Wagss & Freytag A.G. (German) 15% - Del Favero S.P.A. (Italy) 15% - Salini S.P.A. (Italy) 14% - Hydraulic-Power Bureau No.7 (China) 6% - Hydraulic-Power Bureau No. 11 (China) 6%	- Holzmann (German) 44% - Hydraulic-Power Bureau No.6 (China) 12%
Main subcontractors	- French Substructure Company - Tianjin Substructure Bureau	- TEB - OTFF - China Hydraulic-power Bureau No.1 (Liaoning) - No.3 (Shanxi) - No.4 (Qinghai) - Ministry of Railway, Bureau No.18	- FCB (French) - Luoyang Mining Machinery Plant - Luoyang Gold Bureau - Hydraulic-power Bureau No.4 - No.6 (Liaoning) - No.8 (Hunan)

		- Henan Yima Mining Bureau - Henan Jiaozu Mining Bureau - Shanxi Hydraulic-power Bureau - Hydraulic-power Bureau No.11 (Henan) - RODIO (Italy)	- Ministry of Railway, Bureau No.18
Source of manpower	Mainly from Hydraulic-power Bureau No.14 (Yunnan, Kunming) and the unskilled labour are local	Mainly from subcontractors and the unskilled labour are local	Mainly from subcontractors and the unskilled labour are local
Manpower employed at peak of work	2400	9000	2600
Date of winning project	30-04-1994	08-06-1994	30-04-1994
Date of signing draft agreement	28-05-1994	28-06-1994	28-05-1994
Date of signing contract	16-07-1994	16-07-1994	16-07-1994
Contract volume	RMB 560 million	RMB 1. 9 billion	RMB 316 million
	$ 216 million		$ 84.21 million
Time for completion	91 months	84 months	74 months
Date of completion	31-12-2001	30-06-2001	31-07-2000
Date of starting work	June 1994	July 1994	June 1994

Table 6.1. Relevant information of the three major joint ventures.
Source: International Office, Yellow River Hydraulic-power Development Corporation

Table 6.2 Statistics of Foreigners Working on the Xiaolangdi Construction Site



6.4. Pilot Study

Against the problem areas, the intention of the pilot study was to use the project to establish a systematic model for the transfer process of tacit knowledge. The pilot study that lasted for two years, identified the typical management structure of Sino-foreign joint venture in Xiaolangdi by examining the existing resources and interviewing the management staff of the project Lot 1, with which significant insight into the investigation of the dyadic interaction[1] had been approached. Furthermore, the study had established a platform for a more in-depth analysis of transfer process of management know-how between foreign and local partners, in terms of explicit and tacit knowledge transfer, dyadic interaction, channel of transfer and the influencing factors.

6.4.1. Aims and Objectives

The aims and objectives of the Pilot Study were:

- To develop a typical management structure of Sino-foreign joint venture in Xiaolangdi for the identification of the physical structure of the dyadic interaction;
- To develop a model of the transfer of management know-how through human interaction within a Sino-foreign joint venture project;
- To refine the model by using assessment inventory survey.

The study concentrated on the more tacit forms of management knowledge, and how these could be transferred through the vehicle of joint ventures between multinational foreign contractors and new generation of Chinese construction companies. Based upon the premise that tacit knowledge is transferred through human interaction, a basic benchmark model for the transfer process of tacit knowledge has been developed. This Pilot Study was to observe the interaction of a number of dyads, comprising one foreign and one local manager. In so doing, a set of factors and the key elements influencing knowledge transfer had been explored. The results had been incorporated into a model, which will be further developed and validated in the main study.

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[1] This is not to be innovative. "Dyadic interaction" is used to interpret the "communication" and alternatively the "knowledge transfer process" between foreign and local managers.

6.4.2. Assessment Inventory Survey with Interview

As it has been established previously, the nature of the current research has finally resulted in the adoption of a combined methodology, where the Assessment Inventories (see **Appendix 1**) were used as a basic element of the survey, and simultaneously the semi-structured interviews were undertaken. The purpose of deploying this combined methodology was to try to make data collected more accurate and practical to the present research.

The Pilot Study of the current research has been primarily based on the Assessment Inventory and semi-structured interview (see **Appendix 2**) with qualitative analysis. The study also relied on direct observation (of working environment and foreign and local managers within Xiaolangdi Project). The Assessment Inventories, which were designed with an identical set of statements, were delivered to the managers of (both foreign and local) in Xiaolangdi Project. The managers were expected to show their perspective and attitude towards each statement by ticking the possible answers. In each assessment inventory there are in total twenty questions (**see Appendix 1**) which cover:

- General information of method statement
- Authority over method statement
- Reasons of using method statement
- What is transferred
- How is knowledge transferred
- The patterns of knowledge transfer
- The key and critical issues in dealing with method statement
- The aftermath of knowledge transfer

It was assumed that in this approach the information and data collected would be factual, quantitative and with features in common. The assessment inventories would be particularly appropriate at this stage since the aim was to quantify the relative importance of different responses to statements about a set of well-defined topics. It could also provide an overview for researchers to carry out the later interviews.

6.4.3. Semi-structured Interviews

Interviews with the foreign and local partners of the joint venture projects were a valuable source of primary research material and information. The semi-structured interview was adopted in the pilot study of Xiaolangdi Project in order to explore new topics, sensitive and emotive issues based upon the assessment inventory.

The semi-structured interviews were constructed and focused around the central aims and objectives of current research themes. The major questions were asked as follows:

- What has been transferred between foreign and local partners during the execution of the project?
- What are the barriers in achieving successful knowledge transfer?
- How is knowledge being transferred?
- Why is knowledge transferred?
- What is the result of knowledge transfer?

The common concerns generated from the assessment inventories were also taken into consideration during the discussions with interviewees. There are both open-ended and focused questions covered in the semi-structured interviews. The initial open-ended questions were designed to encourage respondents to express their feeling and experiences when they had intimate interaction in the joint venture organisation. This phase of the interview yielded most of the new and significant insights in the study. Then, the questions followed would focus on why knowledge transfer takes place, channel of knowledge transfer, influence factors and dyadic interaction.

6.4.4. Problems in Conceptualising and Measuring Knowledge Transfer

In order to track the tacit knowledge transfer process, an assessment inventory for the present research project was designed and used during the first two study trips to Xiaolangdi when the interviews were undertaken. It was found that the key questions highlighted in the assessment inventory were more theoretical rather than operational on the construction site in Xiaolangdi. There was a gap between understanding academic research problems and approaching the phenomenon of knowledge transfer in the real life world. Therefore, a more approachable and fundamental study was

arranged in July 2000 to the John Laing Life Centre Construction Site in Newcastle upon Tyne, the UK. After this study, a multi-sectional assessment inventory was further developed based upon the original assessment inventory, with a view to approach the measurement of the process of tacit knowledge transfer particularly in dealing with Method Statement in the construction practice. This inventory had been tested and commented in Xiaolangdi by mangers (of foreign and local) during the later trips. Further data were collected primarily by having a Knowledge Transfer Seminar, which was organised in Xiaolangdi, and attended by the managers of foreign and local from the three major joint venture construction organisations and professional consultants of both client and the World Bank. This had enabled the researcher to further develop the assessment inventory.

6.4.5. Systematic Arrangement of the Studies

During the years of 1998 and 1999, total six study trips to Xiaolangdi were arranged. In particular, every study was undertaken with a specific purpose of achieving aims and objectives of the research. Prior to the study, in terms of what to identify and what to finalise, appropriate preparation was made. The interviews were conducted in Chinese and English and were recorded. Table 6.3 shows the systematic arrangement of the Pilot Study.

	Date	Objectives	Achievements
1	29th, 30th, August 1998	Autonomy of joint venture	Typical organisation of Sino-German Joint Venture
2	19th, 20th, April 1999	Building of transfer model	Knowledge transfer model, Knowledge transfer assessment inventory
3	29th, 30th, July 1999	Identification	Motivation of knowledge transfer, influence factors, tacit knowledge transfer
4	28th,29th, September, 1999	Identification	Channel of tacit knowledge transfer, success of tacit knowledge transfer
5	24th,25th, April 2000	Identification and finalisation	Critical issues, critical operation of knowledge transfer
6	2nd, 3rd, August 2000	Method statement	Knowledge transfer in dealing with Method Statement

Table 6.3. Systematic arrangement schedule of the Pilot Study

With the assistance and support of management of Xiaolangdi Project, the six study trips of the Pilot Study to Xiaolangdi were carried out. It was encouraging that interviews were undertaken and aims and objectives of the study had been achieved. The interviewees whom the researcher interviewed were in fact from different countries. Most of them were from joint venture companies, who were contractors and sub-contractors in Xiaolangdi Project while some of them were from the client organisation. An agenda for the interviews is shown in Table 6.4.

Organisation	Nationality	Interviewee
CGIC Joint Venture Xiaolangdi Multipurpose Dam Project	German, Italian, English	3
Yellow River Contractors Xiaolangdi Multipurpose Dam Project	Italian	2
Enterprise Development Yellow River Water & Hydropower Development Corporation	Chinese	10
Construction Economics Ministry of Construction	Chinese	1
International Co-operation Division Construction management department Ministry of Construction	Chinese	3
Candian International Project Managers (Consultant to the World Bank and the Client)	Canadian	6
Total		**25**

Table 6.4. Interview agenda of the Pilot Study

6.5. Presentation of Pilot Study Data

This section will first of all discuss the data collection process. Then the section will present an anatomy of joint venture projects, with implications of the physical structure of management dyads composed of a local and a foreign element. Furthermore, the section will present findings of the Pilot Study and the benchmark model of tacit knowledge transfer.

6.5.1. Data Collection Process and Quantitative Data

Data were collected primarily by individual interviews with the managers (foreign and local) of the relevant construction organisations. This had enabled the researcher

to track the development of collaborative relationships over time. Qualitative data (refer the Transcription of Interviews in the Pilot Study in **Appendix 2**) were collected directly from interviews and observations in the field study. Quantitative data were obtained from the results of the assessment inventories.

The quantitative data presented here is in the form a summary of the fifty-two copies the assessment inventories returned to the researcher. Based on the previous study trips, fifty-two copies of the assessment inventory with an identical set of questions were delivered to the managers (of both local and foreign) in Xiaolangdi Project and all the copies were returned. The assessment inventories were designed in both English and Chinese version. The English versions are for foreign partners while the Chinese versions are for the local partners. A summary of all the responses in the Pilot Study is presented (**see Appendix 4**).

6.5.2. Typical Management Structure of Sino-foreign Joint Venture

The primary interest of this research was in how tacit knowledge was transferred through human interaction. The unit of analysis would therefore be a dyad with one foreign member and the other local, and whose roles demand that they work together. Based on the interviews of foreign and local managers, a typical management structure has been established. This is important not only because it can provide better understanding of a joint venture organisation, but also because it is the first step to present an anatomy of joint venture projects, which will establish a platform to enable the researcher to have further study of the knowledge transfer process through the analysis and observation of dyadic interaction.

The following points in the typical management structure of joint venture bear significant implications for the further study of the knowledge transfer process.

- Foreign manager with Chinese assistant in each department;
- Minority foreign engineers with majority Chinese engineers in each department;
- There is no foreigner in the Safety Department.

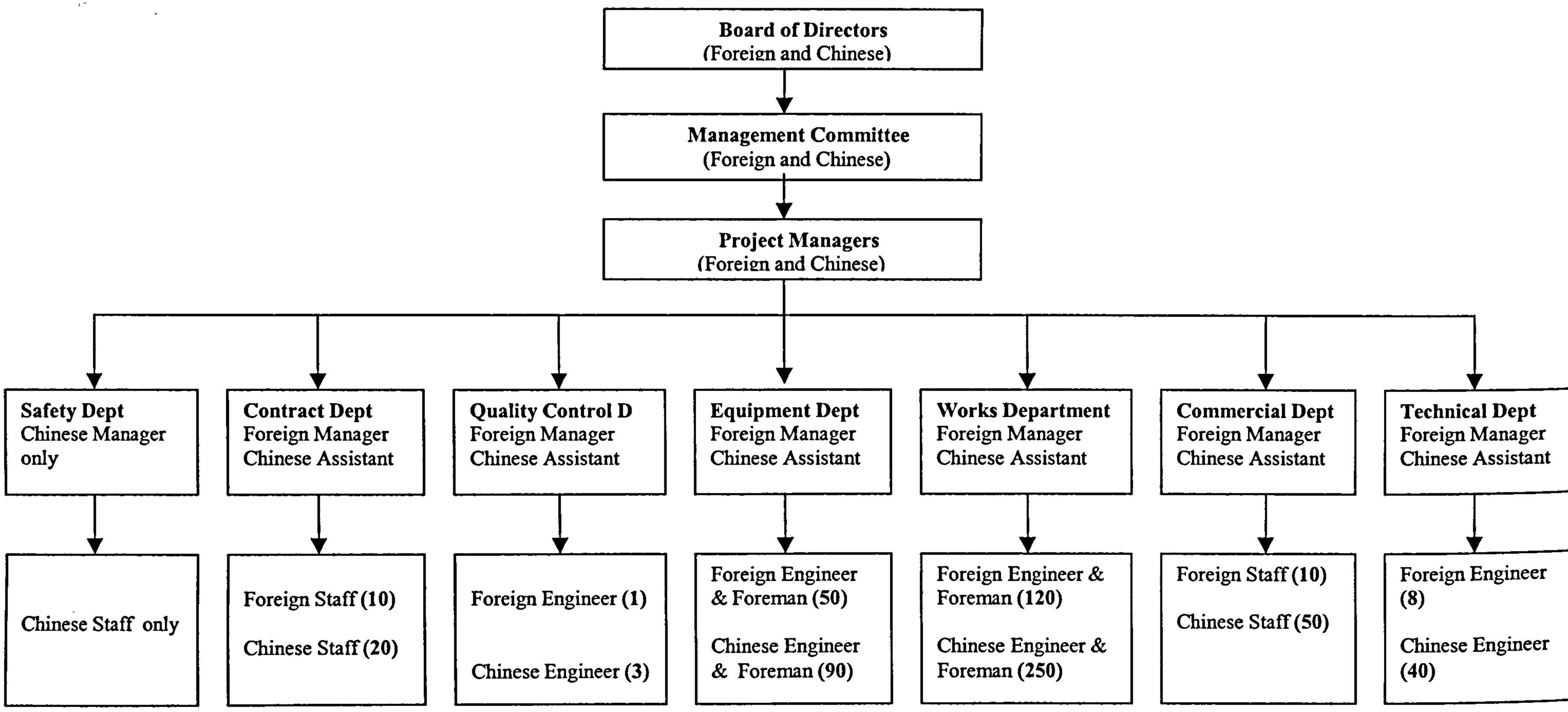

Figure 6.2. Typical Management Structure of Sino_foreign J.V. in the Xiaoliangdi Project, PRC

Figure 6.2 shows the typical management structure of a Sino-foreign Joint Venture in the Xiaolangdi Project, from which we can identify the physical structure of the dyadic interaction within the joint venture. An interesting point that we noticed that there is no foreign staff in the Safety Department, as it is believed that there exists the measures and requirements in terms of health and safety in construction provided by the Chinese government.

6.5.3. Tacit Knowledge Transfer

The empirical evidence identified through the pilot study of the Xiaolangdi project (Li and Greenwood, 2000) has shown that tacit knowledge transfer occurs from time to time during the execution of the project between members of management dyads, composed a foreign (F) and a local (L) element (refer **Appendix 3**). The pilot study permitted the identification of the various 'dyads' or management pairs of individuals who inter-react with each other as part of their managerial role. In fact these dyads are numerous, and made up of foreign-foreign (F-F), foreign-local (F-L), local-local (L-L) but for the immediate purposes of the current research, only the foreign-local (F-L) dyads are of interest. Figure 6.3 represents the work patterns of dyadic interaction.

Pattern 1 Foreign-Foreign
Pattern 2 Local-Local
Pattern 3 Foreign-Local

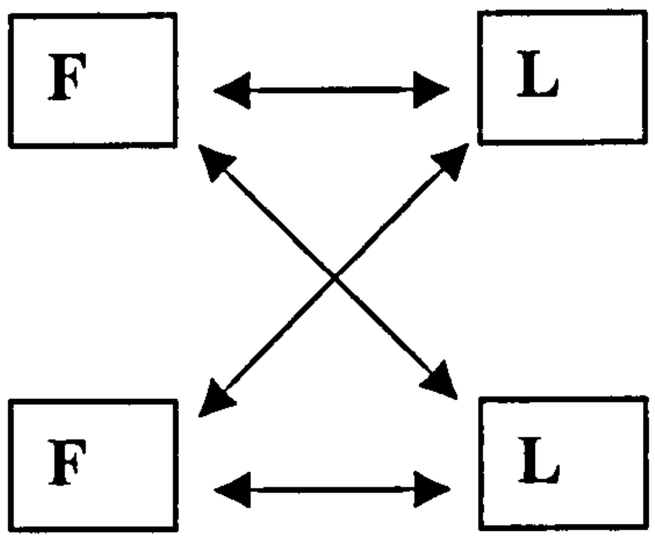

Figure 6.3. Work patterns of dyadic interaction

6.5.4. Influencing Factors

Many factors are cited as potential barriers to the success of technology transfer. Samli (1985) considered six dimensions – geography, culture, economy, people, business, and government. In addition to the above dimension, contrary to the motivation of tacit knowledge transfer, one of the important barriers is the resistance

of change or the unwillingness to accept knowledge transfer. It seems that there is a tendency for the elderly to be reluctant to have knowledge transfer.

Within the context of Hofstede (1980) and Hofstede and Bond's (1988) five dimensions of culture and based on the model of technology transfer developed by Tung (1994), the Pilot Study of Xiaolangdi Project has made a further investigation of the following influencing factors:

- Cultural difference
- Language barriers
- Social values
- Different objectives
- Technical development level

These factors will be incorporated into the research model and further explained in the main study.

6.5.5. Motivation for Knowledge Transfer

The data collected through semi-structured interviews suggests that on the construction site in Xiaolangdi, the local partners are keen to have knowledge transferred by the foreign partners, particularly tacit knowledge such as practical management know-how, problem-solving and decision-making techniques. It is true that the transferee does not only want to absorb "know-how" but also "know-why". As a matter of fact, the transfer of know-how and skills from one group to another group is an act of power. However, the foreign partners believe that transferring management knowledge to partners is an effective approach to completing the construction project. It seems therefore that there is congruence between transferor and the transferee in the desire to see tacit knowledge being transferred.

It should be noted that under the commercial pressures of completing a project to time, quality and cost, it is not always feasible to undertake a formalised commitment to transfer. Many commentators believe that this needs to be organised and funded separately.

6.5.6. Mechanisms of Transferring Knowledge

The result of the Pilot Study of Xiaolangdi Project suggests that method statement appears to be in (a) formal form, such as well-structured written form, and (b) informal form, such as a simple note, a rough sketch, and sometimes a method statement can be in a verbal form, such as a message. Explicit knowledge is often transferred through well-structured written form while tacit knowledge is transferred when the message has been passed by. The foreign party normally has the final say in terms of hard construction technology in dealing with the method statement. However, it should be noted that 80% of the respondents of foreign and local managers in Xiaolangdi confirmed that knowledge transfer, in particular in terms of management know-how is a "two-way process" between multinational and local partners while 8% of the respondents believe that knowledge transfer is one way from foreign to local.

6.5.7. What Is Being Transferred

It should be pointed out 84% of the respondents stated in the inventories that there is more demand of tacit knowledge transfer such as soft knowledge, management know-how than for explicit knowledge transfer such as hard knowledge, construction technology, which has been in line with the result of the previous interview. There is less demand of knowledge transfer in dealing with technical problems, such as construction technology; however, there is significant demand for knowledge transfer in dealing with administrative problems, in particular, claims and anti-claims. Local partners are eager to absorb management know-how in dealing with claims and anti-claims. Under the centralised planning economy, construction itself was regarded as construction, not a means for making profits. However, in the market economy, construction has been taken as an approach of making large profit. Therefore, claims and anti-claims have become critical issues in the whole life of a project.

6.5.8. A Model of Knowledge Transfer

As described in the previous section, knowledge can be divided into two components, namely explicit and tacit. Explicit knowledge and tacit knowledge have different channels of transfer, which has been developed in the Pilot Study in Xiaolangdi.

Given the nature of both explicit knowledge and tacit knowledge, with consideration of the joint venture vehicle, a basic model of knowledge transfer was constructed.

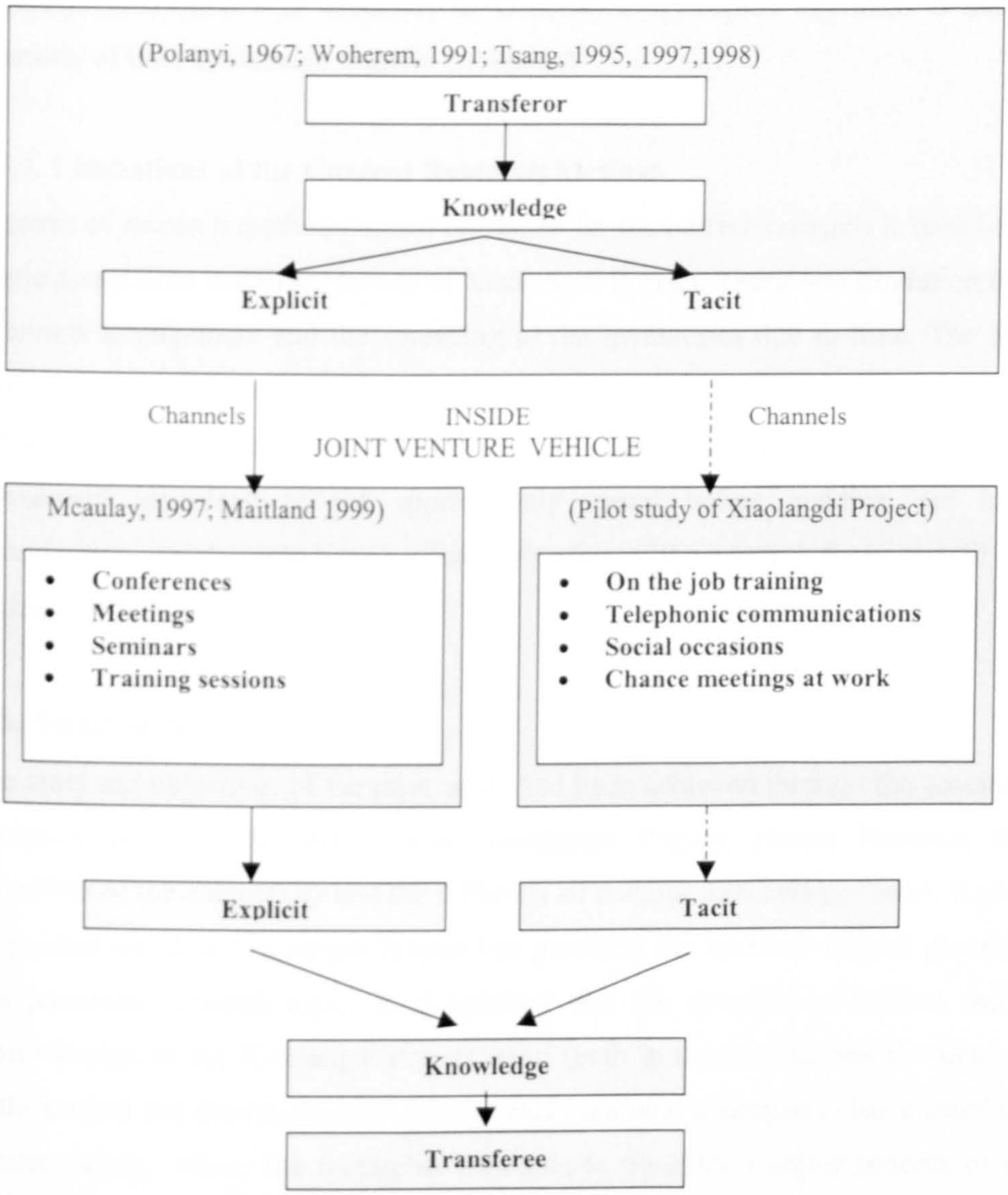

Figure 6.4. A model of knowledge transfer

Figure 6.4 represents the benchmark transfer model of both explicit knowledge and tacit knowledge, generated from the literature (Polanyi, 1967; Woherem, 1991; Tsang, 1995, 1997, 1998; Mcaulay, 1997; Maitland, 1999) and refined using data from the Pilot Study. However, it should be noted that in this presentation the flow of explicit knowledge is in a solid line while the flow of tacit knowledge is in a broken line. It

should be emphasised that the transfer of explicit knowledge is easy to track, however, while transfer of tacit knowledge is hard to track. In the meantime, the certain channels that have been identified through the pilot study are believed to be arbitrary. Therefore, it is necessary to establish a systematic approach to keep the channels of tacit knowledge transfer unblocked.

6.5.9. Limitations of the Current Research Method

In terms of research methodological issues, so far the current research is based on the single assessment inventory survey of Xiaolangdi Project. There was limitation for the interview arrangement and the spreading of the inventories due to time. The results and conceptual issues generated from the pilot study therefore need to be further tested in the main study. In addition, the validation of questions designed in the assessment inventory is not appropriately tested before sending out to the interviewees, which might have caused misleading of the research focus and direction during interviews.

6.6. Summary

The aims and objectives of the pilot study had been achieved through the assessment inventory survey with interviews in Xiaolangdi Project, Henan Province, PRC, regardless of the complexity and the difficulty of making such arrangements. It should be pointed out that Xiaolangdi Project has provided the research culture ground for this particular research topic. It is believed that the diversity of culture and the sophistication of the Xiaolangdi Project itself (both in terms of technical complexity of the project and the construction of it by multi-national contractors) has created such a surrounding, where the researcher was able to track the transfer process of tacit knowledge. The study has generated significant insights and fundamental findings at this stage. Furthermore, the study that has established a platform for undertaking the Main Study, will bridge the theoretic literature review in the academic world and the exploration of the phenomenon of the knowledge transfer in the real construction site.

The significance of the findings from such a study is that it not only makes possible further research into mechanisms of knowledge transfer, and but also because it helps

to develop the understanding of the mechanisms of knowledge transfer between the developed and developing countries.

Furthermore, this study discovers that explicit knowledge is easy to track but represents only part of knowledge transfer. Therefore, the importance of tacit knowledge transfer should be and must be established. In the mean time, it is necessary to suggest that tacit knowledge transfer can be accomplished in a systematic way rather than *ad hoc* manner.

Chapter Seven

A Study of Jiangsu, Henan and Xinjiang

7.1. Introduction

First of all, this chapter briefly presents information on three regions: Jiangsu Province, Henan Province and Xinjiang Autonomous Region. These are the regions in which the Main Study was carried out. Then the chapter provides a number of economic indicators with particular reference to construction activity, which is believed to provide a broader context for the further understanding of the present economic status of the provinces and the region. Furthermore, the chapter focuses on a horizontal comparison of the economic indicators in these provinces and region. The chapter concludes with a summary.

7.2. Jiangsu Province, Henan Province and Xinjiang Autonomous

The three locations of Jiangsu Province, Henan Province and Xinjiang Autonomous Region have been selected as samples of study of construction industry in China, not because they are typical examples of the Chinese experience, but as instances representing the different economy in the country. A map of China attached (Figure 7.1.) shows the geological locations of the three regions in the People's Republic of China.

A literature review shows that there is no academic work that examines the current situation of the economic development of the provinces and autonomous regions in PRC. However, Table 7.1 was established based on the Construction Statistical Yearbook of China, 1998, which shows the current positions of Henan, Jiangsu and Xinjiang ranked by gross output value (GOV) of construction in the country. It is hoped that the construction activities in these regions will reflect the different levels of economic development in the construction industries in China.

Figure7.1. A map of China showing the locations of Jiangsu, Henan and Xinjiang

Table 7.1. League Table of Provinces and Regions in PRC

Table 7.1. League Table of Provinces, Municipalities (directly under the Central Authorities) and Autonomous Regions in China by Gross Output Value of Construction

	Name	Capital City	GOV in RMB 1998
1	**Jiangsu**	**Nanjing**	**10,716,094**
2	Zhejiang	Hangzhou	8,773,546
3	Guangdong	Guangzhou	6,747,406
4	Shandong	Jinnan	6,479,717
5	Shanghai	Shanghai	5,524,161
6	Sichuan	Chengdu	5,206,436
7	Beijing	Beijing	5,192,363
8	Liaoning	Shenyang	4,291,256
9	Hebei	Shijiazhuang	3,760,962
10	Hubei	Wuhan	3,059,698
11	Hunan	Changsha	2,965,005
12	**Henan**	**Zhengzhou**	**2,946,903**
13	Chongqing	Chongqing	2,440,552
14	Heilonhjiang	Harbin	2,435,310
15	Anhui	Hefei	2,359,972
16	Fujian	Fuzhou	2,268,855
17	Yunnan	Kunming	2,189,844
18	Shanxi	Taiyuan	1,920,095
19	Tianjin	Tianjin	1,909,999
20	Shaanxi	Xi'an	1,642,493
21	Jilin	Changchun	1,369,882
22	Guangxi	Nanning	1,275,627
23	**Xinjiang**	**Urumqi**	**1,141,318**
24	Gansu	Lanzhou	1,056,249
25	Neimonggou	Huhhot	963,852
26	Jiangxi	Nanchang	856,436
27	Guizhou	Guiyang	767,046
28	Ningxia	Yinchuan	334,919
29	Qinghai	Xining	309,340
30	Hainan	Haikou	279,923
31	Xizhang	Lhasa	79,519

1. Jiangsu Province

The economy in Jiangsu Province has grown steadily and quickly since the economic reform starting from 1978. Jiangsu, with a population of 71 million and an area of 102,600 square kilometres, is making the most of its productive location in the Yangtze River Delta. A chief economic indicator in one of China's most developed provinces, Jiangsu's GDP reached RMB335.8 billion (US$48.5 billion), 10% increase

over the same period of the previous year. Jiangsu is the birthplace of many of China's most important national industries. For years the value of its industrial output has ranked first in the country.

The added value of state-owned enterprises and non-public industrial enterprises with sales revenues of 5 million yuan (US$602,400) came to 102 billion yuan (US$12.3 billion), 11.7% more than that of the previous year. This growth was 2.3% above the national average. Jiangsu's export value topped US$7.7 billion in the first half of 1999. This number is an increase of 12.6% over the same period of the previous year. The volume of foreign trade and foreign investment for the province has surpassed one-fourth of its GDP as well as its fixed assets. By the end of 1998, there were 20,500 foreign-funded enterprises in Jiangsu, and 15,000 of them are fully operational. Foreign investments have grown to US$36 billion.

Since the reforms and open market policies took effect in the late 70s, Jiangsu's economy developed rapidly. In the past two decades, the annual growth rate was 12.8%. The province has also made breakthroughs in infrastructure. A modern transportation network has gradually grown across the province. The Shanghai-Nanjing Expressway, as well as the Nanjing-Lianyungang and Nanjing-Nantong grade A highways, now open to traffic, have made economic and social development easier. Two other projects, the Nanjing Lukou International Airport and South Jiangsu section of the Beijing-Hangzhou Grand Canal, have been completed. A third transportation magnet, the Jiangyin-Yangtze River Road Bridge, is now also open to traffic. Construction on two other key projects, the Nanjing Yangtze River No 2 Bridge and the North Jiangsu Expressway, has meanwhile been accelerated[1].

2. Henan Province

Located in the central and eastern part of China, at the middle and lower reaches of the Yellow River, Henan Province has an area of 167,000 square kilometres and a population of 88.61 million. It was the birthplace of the Yellow River Culture. According to a large number of popular legends and historic records, it was here that

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[1] This is derived from the Internet page of *China International Economic Consultants Co.,Ltd(CIEC) Issued date: December 28, 1999.*

Fuxi, Nuwa, Xuanyuan Huangdi, Diku, Zhuanxu, the ancestors of the Chinese nation, created Chinese civilization.

The Yellow River basin has been called the cradle of the Chinese nation where mankind lived as early as 500,000 to 600,000 years ago. In Henan Province several hundred cultural sites of the Neolithic Age (4,000 to 10,000 years ago) have been found. The famous Peiligang, Yangshao, and Longshan Cultures reflect the prosperity in this area during the late period of primitive society. From the period of 21st century B. C., when the Xia Dynasty, the first dynasty in China's history, was established, to the Northern Song Dynasty, more than 20 dynasties with more than 200 emperors set or moved their capital cities here.

Henan Province has eight high-new technology industry development zones and seven provincial economy & technology development zones, with Zhengzhou and Luoyang being the country high-new technology industry development zones. There are two first-class airports (Zhengzhou and Luoyang), one first-class railway port (Zhengzhou East Railway Station), three second-class highway ports (Zhengzhou, Luoyang and Shangqiu) in Henan. In 1998, the whole province makes use of about 1.034 billion dollars foreign investment.

Henan Province has opened more sectors to foreign investors. In addition to the technology industry, the province has opened to overseas investors agricultural industry, stockbreeding industry, transportation industry, service industry, retail industry, education, pharmaceutical industry, land exploitation and so on. Currently, investors from more than 60 countries, including Japan, the United States, Germany, Britain and Singapore, have come to Henan to develop their business. Totally, there are more than 2000 joint ventures in Henan. The province has 101 cities and towns open[2] to foreigners, with almost every city or town having at least one joint venture. Henan has established co-operation and science-technology communication with more than 30 countries and districts. It also has made long term and relatively stable science-technology co-operation with some research institutes in Japan, the United

[2] This means a city where infrastructure and investment surrounding have been well established to accommodate foreign investors.

States, Germany, Britain and so on. In 1998, Henan's total turnover reached to US$69.94 million, an increasing 7.6 percent compared with the previous year[3].

3. Xinjiang Autonomous Region

Xinjiang is the shortened name of Xinjiang Uygur Autonomous Region. Xinjiang has a population of 17.18 million. Situated in Northwest China and in the centre of the Eurasian continent, it is over 1,600,000 square kilometres in area, making up one-sixth of the entire territory of China, the biggest of all the country's provinces and autonomous regions.

Xinjiang's economy presents a good situation of "high increase and low inflation". There are bumper harvests in agriculture and rapid increases in industrial production. Investment, consumption and exports have maintained a certain degree of increase. The financial and monetary situation is regular. But at the same time, with economic development, there appear problems that cannot be ignored. The basis for further economic development is not stable yet; the pace of structural adjustment is still slow; the production management of state-owned enterprises is difficult; and the overall situation of the economy is still not ideal.

As a major region in the development of west China, Xinjiang is abundant in exploitable resources and has great potential for developing the feature economy and forming new economic growth points. Xinjiang, also rich in mineral resources, plans to construct China's biggest petroleum and natural gas industrial base and an important petrochemical industrial base in west China in the coming five years. Meanwhile, it will finish constructing a textile production base, a non-ferrous metals industrial base and other industrial bases.

Infrastructure construction, focused on transportation and water conservancy, will also be a key local industry requiring major input in the next five years. The Xinjiang government plans to invest 70 billion yuan in infrastructure construction, 23 billion

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[3] This is derived from Internet page of *The People's Government of Henan Province, PRC China, China Council for the Promotion of International Trade, Henan Multimedia Information Bureau, Henan Info.Port, 2000.*

yuan of which will be directed into highway construction and renovation. Besides, it will speed up the construction of China-Kirghizia-Uzbekistan Railway, improve the infrastructure of Urumqi and Kashi airports, and quicken the construction of communication information network. Xinjiang neighbours Gansu province and Qinghai Province in the Southeast and Tibet in the South; and borders eight countries in all the other directions, that is, Mongolia in the Northeast, Russia, Kazakhstan, Kyrgyzstan and Tajikistan in the Northwest and Afghanistan, Pakistan and India in the Southwest. The region has a national boundary over 5,000 kilometres long, longer than that of any other of the country's provinces and regions. The situation endows Xinjiang with a natural geographical advantage for its reform and opening to the outside world.

Xinjiang is surrounded by mountains. It depends upon snow-melt water from these mountains to irrigate its oases. Xinjiang's oases are isolated, separated from each other by large expanses of desert. Transportation is poor and expensive; as a result many regions are basically closed economies. In 1992, the average income of people in the Hotan region was 903 RMB per year and 1185 in Kashgar, respectively the lowest and third lowest per capita income of Xinjiang's regions.

From 1949, ethnic Han emigration to Xinjiang rose and fell with events in eastern China. The great majority of the emigrants to Xinjiang in 1990 [88 percent] came from rural China but were in general better educated than the average Xinjiang resident. Xinjiang will pay more attention to the ecological environmental construction and attach equal importance to environmental protection and pollution control.

7.3. Economic Indicators in Construction Industry

As has been established previously, this study set its boundary within the context of construction industry in China. It should be noted that it is hard to obtain the up-dated data of economic development in a changing environment, in particular with construction sector in the fast and ever-changing economy in China.

In order to identify the different levels of construction industry among Jiangsu, Henan and Xinjiang, a certain number of economic indicators have been chosen from the

Year Book of 1998, which was compiled by the Department of Statistics on Investment in Fixed Assets of State Statistical Bureau, published by China Statistical Publishing House, to be presented in Table 7.2.

The intention is to have a comparative study between the main economic indicators in construction and the economic indicators of foreign funded economic units in the three regions. Therefore, two sets of economic indicators have been chosen. One set concerns main economic indicators of the whole industry of the three regions, such as the following:

- Gross output value of construction
- Number of projects
- Construction quality projects
- Statistics on machinery and equipment
- Value added of construction
- Total floor space completed
- Total capital and structure of total assets
- Liabilities and creditors' equity
- Total profit
- Total number of construction enterprises

The other set concerns economic indicators of construction enterprises of foreign founded economic units, which includes foreign funded economic units, economic units funded by entrepreneurs from Hong Kong, Macao and Taiwan, and units of other types of ownership. These indicators are as the following:

- Gross output value of construction

Table 7.2 Main Economic Indicators of Construction in Jiangsu, Henan and Xinjiang, PRC

	Jiangsu	Henan	Xinjiang	National Total	Remarks
1. Gross output value of construction (10000 yuan)	10,716,094	2,946,903	1,141,318	91,264,777	10,000 yuan
2. Number of projects (projects)	63,888	29,714	11,877	678,767	Project
3. Construction quality projects (projects)	14,578	6,593	1,695	131,337	Project
4. Statistics on machinery and equipment (pieces)	560,987	244,518	64,252	5,604,603	Piece
5. Value added of construction (10000 yuan)	2,620,881	795,700	345,229	25,405,426	10,000 yuan
6. Total floor space completed (10000 sqare metre)	15,750.6	4,984.4	1,400.3	128,680.3	10,000 square metre
7. Total capital and structure of total assets (10000 yuan)	1,979,955	583,130	309,044	22,316,538	10,000 yuan
8. Liabilities and creditors' equity (10000 yuan)	8,241,901	1,906,875	1,018,007	79,137,411	10,000 yuan
9. Total profit (10000 yuan)	113,507	26,029	-4,347	1099,170	10,000 yuan
10. Total number of construction enterprises (companies)	3,195	1,975	650	44,107	Company
Construction Enterprises of Foreign Funded Economic Units					Note 1
1. Gross output value of construction (10000 yuan)	95,065	10,343	0	704,912	10,000 yuan
2. Number of projects (projects)	853	97	0	4,539	Project
3. Construction quality of project (projects)	156	37	0	637	Project
4. Statistics on machinery and equipment (pieces)	2,936	329	0	29,228	Piece
5. Value added of construction (10000 yuan)	21,281	3,248	0	163,739	10,000 yuan
6. Total floor space completed (10000 square metre)	37.5	0.9	0	196.8	10,000 square metre
7. Total capital and structure of total assets (10000 yuan)	19,384	3,049	0	259,947	10,000 yuan
8. Liabilities and creditors' equity (10000 yuan)	61,114	9,864	0	548,588	10,000 yuan
9. Total profits (10000 yuan)	4,031	251	0	32,212	10,000 yuan
10. Total Number of foreign funded economic units (companies)	37	11	0	454	Company

Note 1:This category of construction enterprises includes foreign funded economic units, economic units funded by entrepreneurs from Hong Kong, Macao, and Taiwan, and units of other types of ownership

- Number of projects
- Construction quality projects
- Statistics on machinery and equipment
- Value added of construction
- Total floor space completed
- Total capital and structure of total assets
- Liabilities and creditors' equity
- Total profit
- Total number of construction enterprises

Table 7.2 shows the various economic indicators of construction industry in Jiangsu Province, Henan Province and Xinjiang Autonomous Region.

7.4. Comparison among the Three Regions

It is not intended to present any particular mathematical relationship or models by presenting the following bar charts. All the bar charts are mere visual aids showing the main features of construction industry among these regions. This is to allow for a horizontal comparison of the various economic indicators of construction industry among Jiangsu Province, Henan Province and Xinjiang Autonomous Region in Peoples' Republic of China. Chart 1 – 20 present the comparison of the economic indicators among Jiangsu Province, Henan Province and Xinjiang Autonomous Region.

7.4.1. Main Economic Indicators in Construction

Chart 1-10 show the mere comparison of main economic indicators in construction industry in Jiangsu Province, Henan Province and Xinjiang Autonomous Region, Peoples' Republic of China.

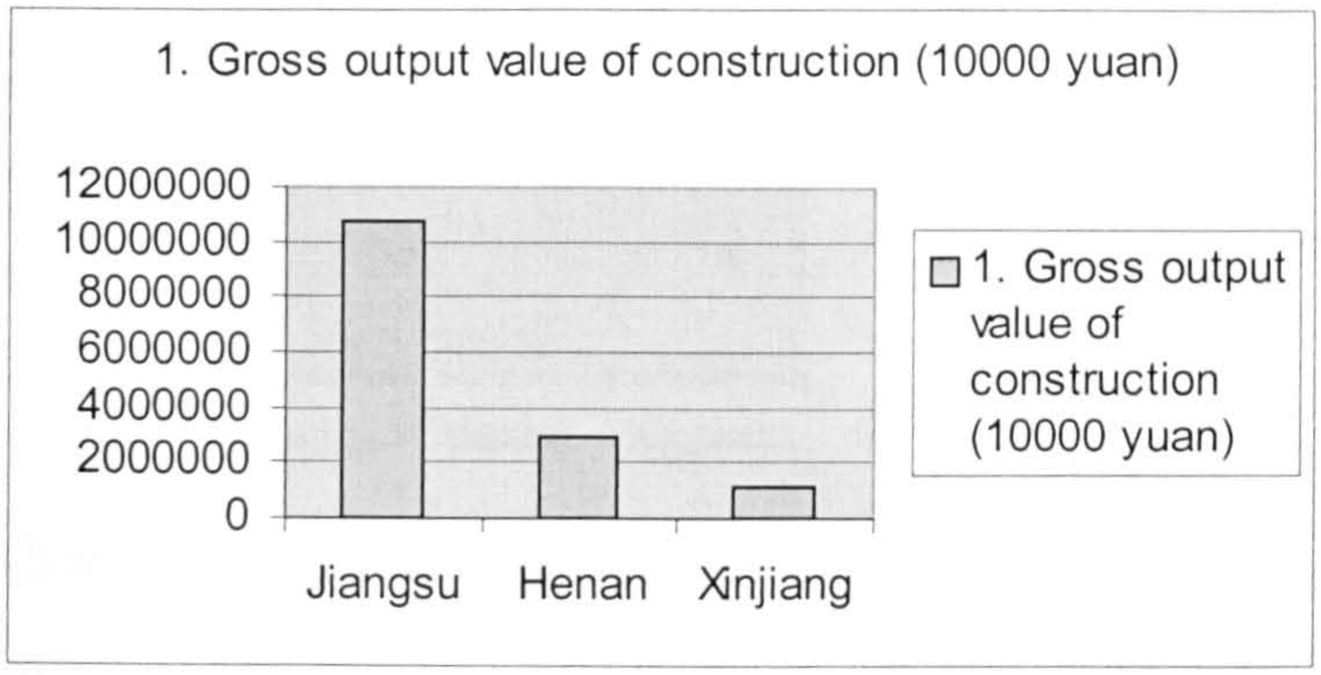


Chart 1. Gross output value of construction

Chart 1 shows the comparison of the gross output value (GOV) of construction among the three regions. GOV is the total value of construction products shown in terms of currency that were completed by the construction enterprises up to date. It is an important indicator to reflect production scale and development speed of construction industry, which is an important base to calculate the economic results, labour productivity and the proportion of construction industry in the national economy.

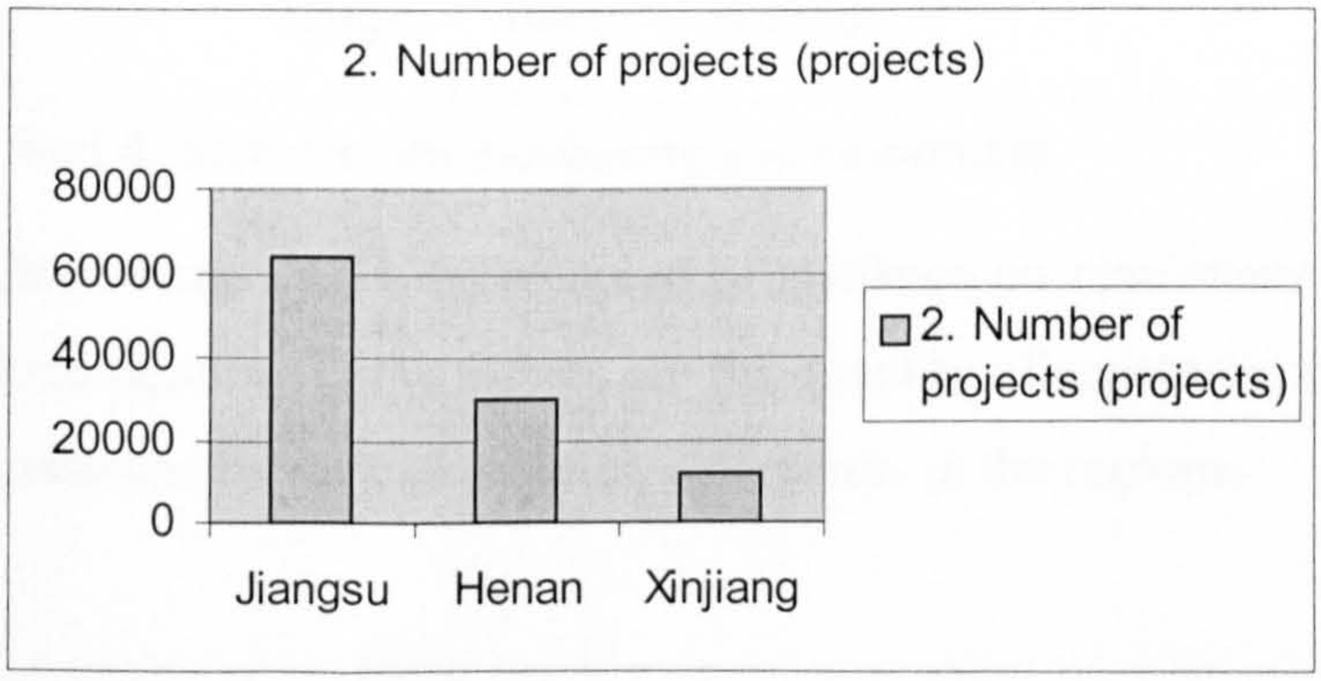


Chart 2. Number of projects

Chart 2 shows the comparison of number of projects among the three regions. The number of projects means the total number of projects completed by the construction enterprises in the regions so far.

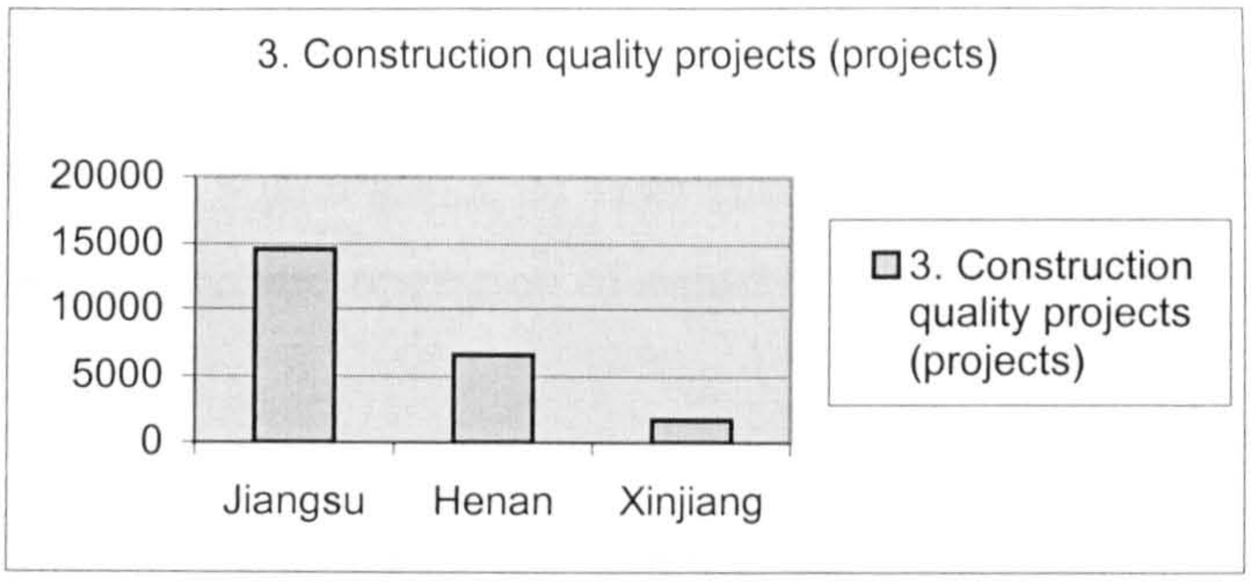


Chart 3. Construction quality projects

Chart 3 shows the comparison of construction quality projects among the three regions. The construction quality project means construction projects completed with high quality. Most items were completed in accordance with the required standard. This is often assessed and examined by construction experts.

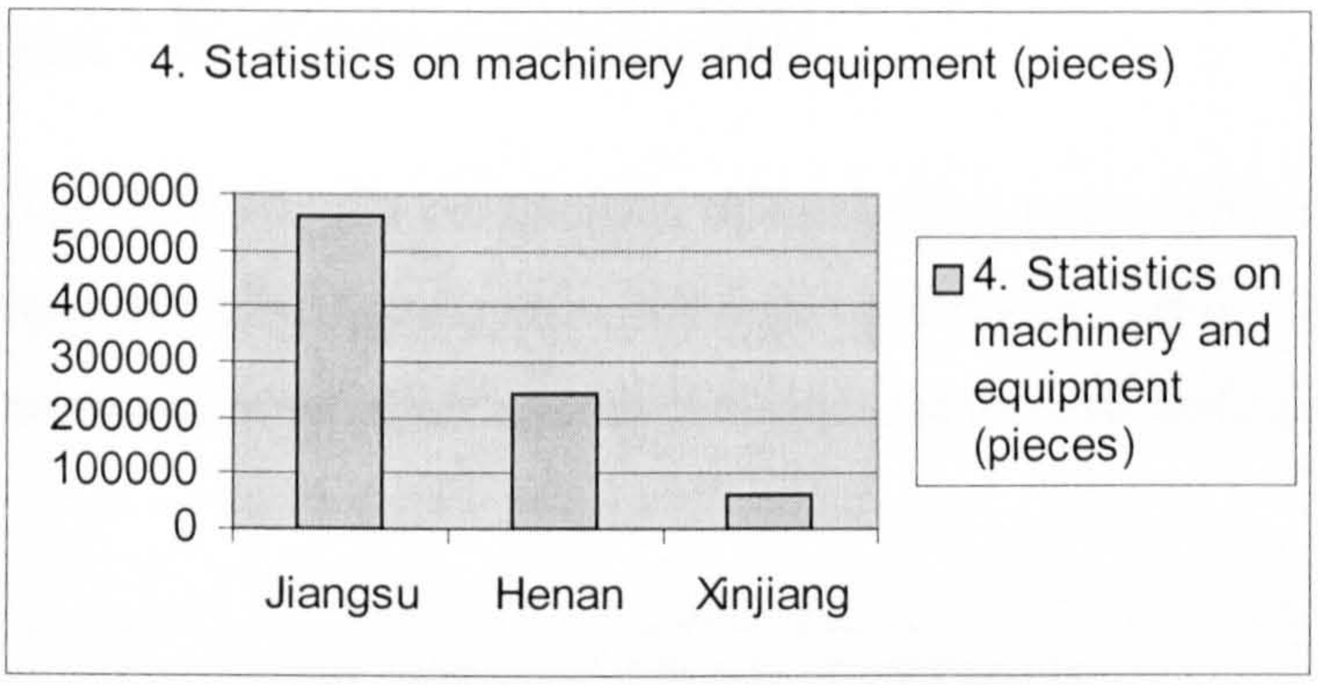


Chart 4. Statistics on machinery and equipment

Chart 4 shows the comparison of statistics on machinery and equipment among the three regions. These figures are the quantity of construction machinery and equipment possessed by the construction enterprises in the regions.

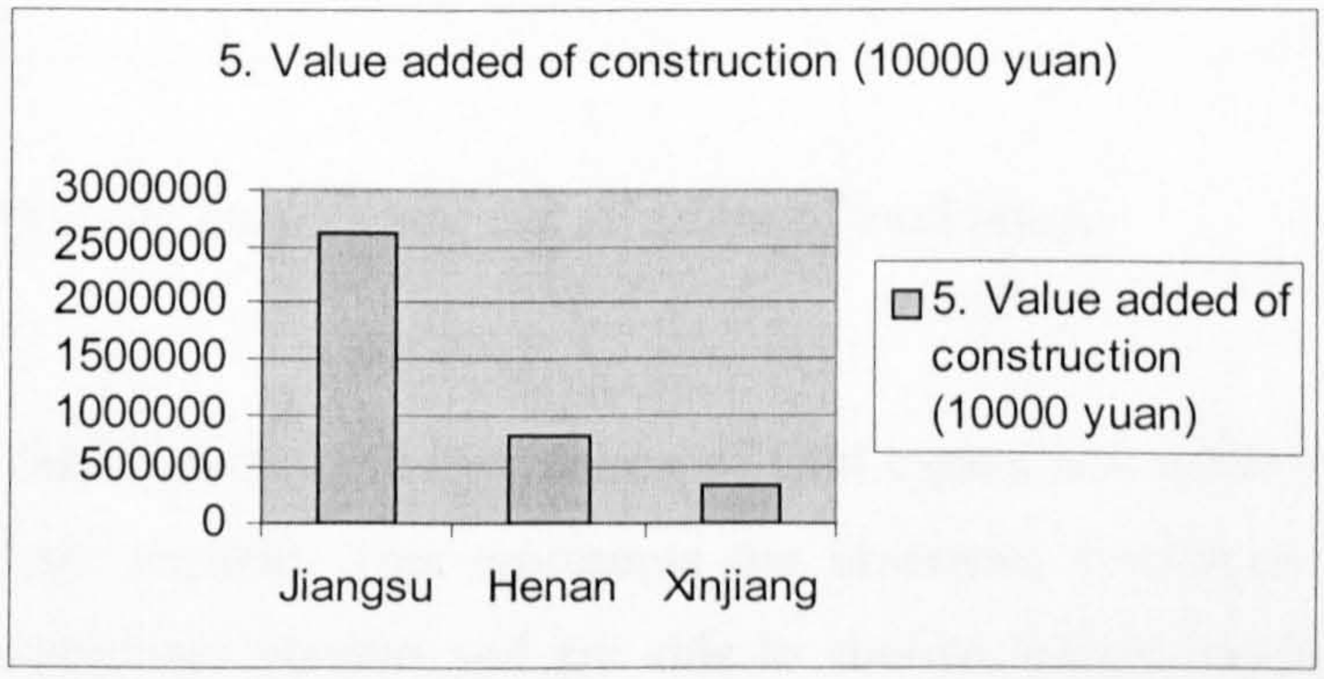


Chart 5. Value added of construction

Chart 5 shows the comparison of value added of construction among the three regions. Value added of construction means the final result in terms of currency of production and operation of construction industry up to date.

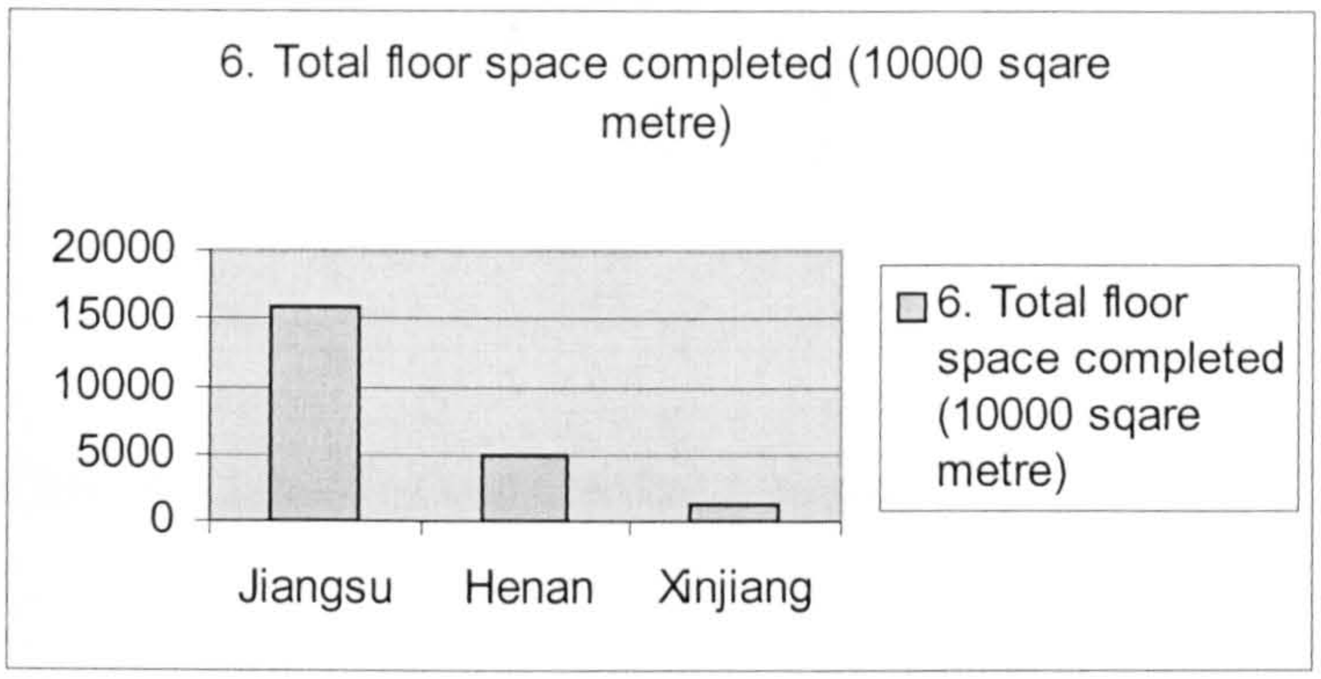


Chart 6. Total floor space completed

Chart 6 shows the comparison of total floor space completed so far among the three regions. These figures show the total construction areas completed in accordance with the requirement of architectural design and put into utilisation.

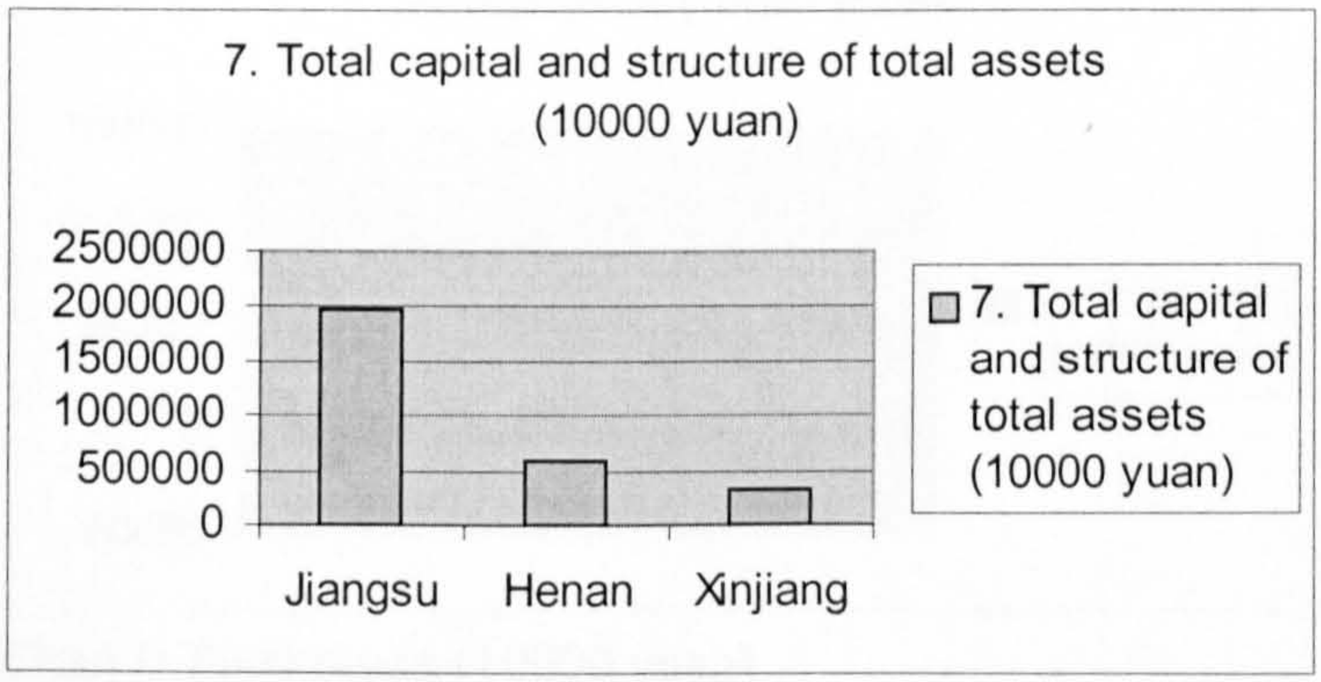


Chart 7. Total capital and structure of total assets

Chart 7 shows the comparison of total capital and structure of total assets among the three regions. This represents the economic resources in terms of currency that enterprises possess and are able to control, which includes operational assets, long term investment, fixed assets, special items, invisible assets and other assets.

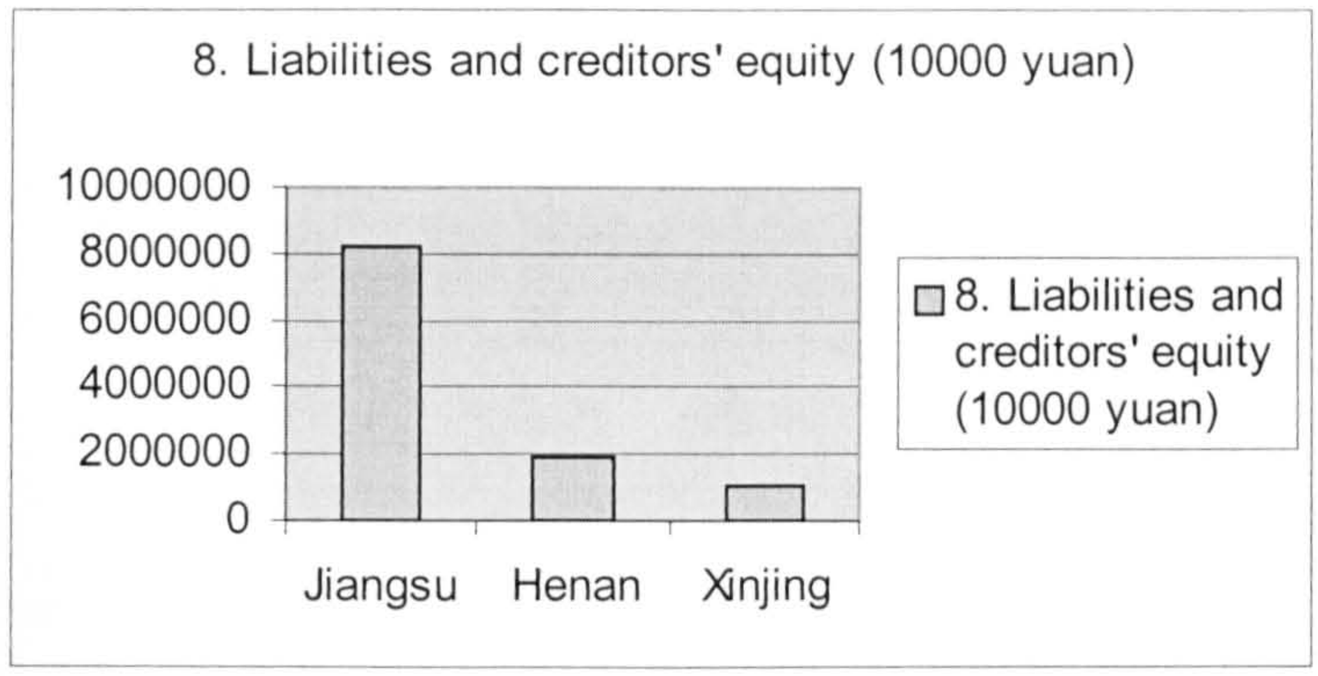


Chart 8. Liabilities and creditors' equity

Chart 8 shows the comparison of liabilities and creditors' equity in construction industry among the three regions. This means the liabilities and creditors' equity that the enterprises would pay in terms of capital or manpower. It should be pointed that this indicator still bears features of the command economy.

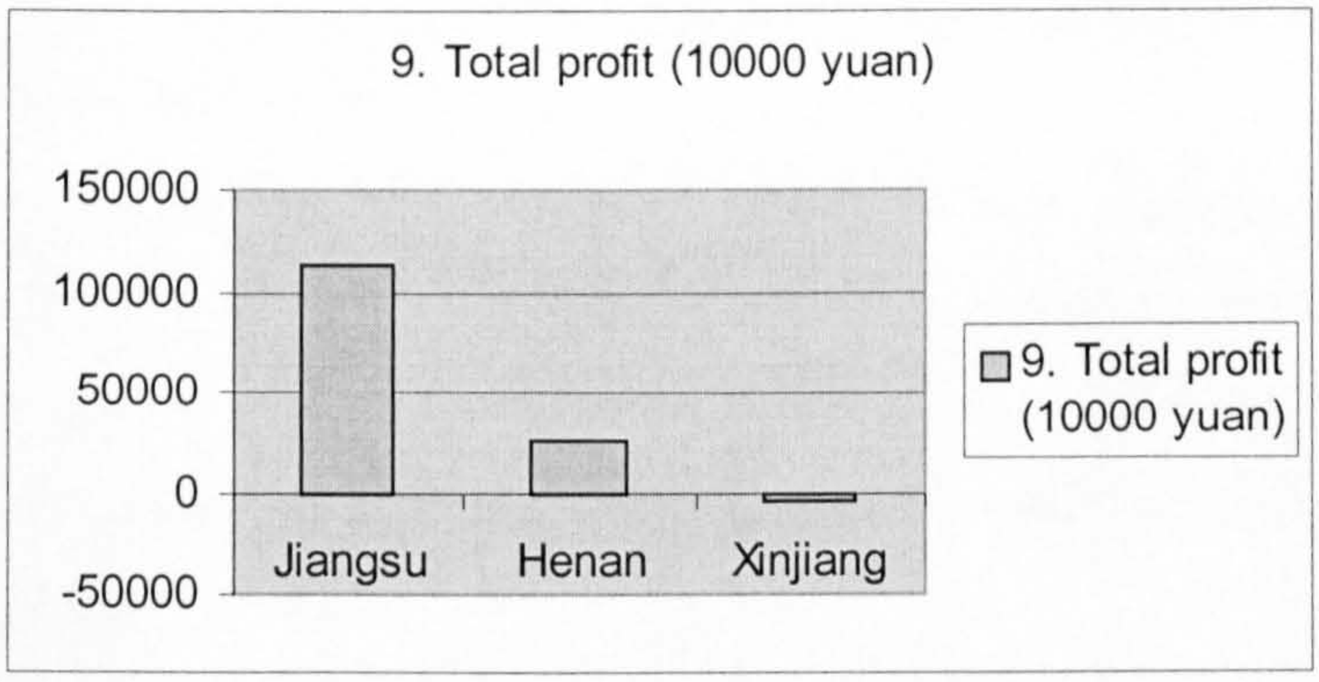


Chart 9.Total profit (10000 yuan)

Chart 9 shows the comparison the total profit of construction industry among the three regions.

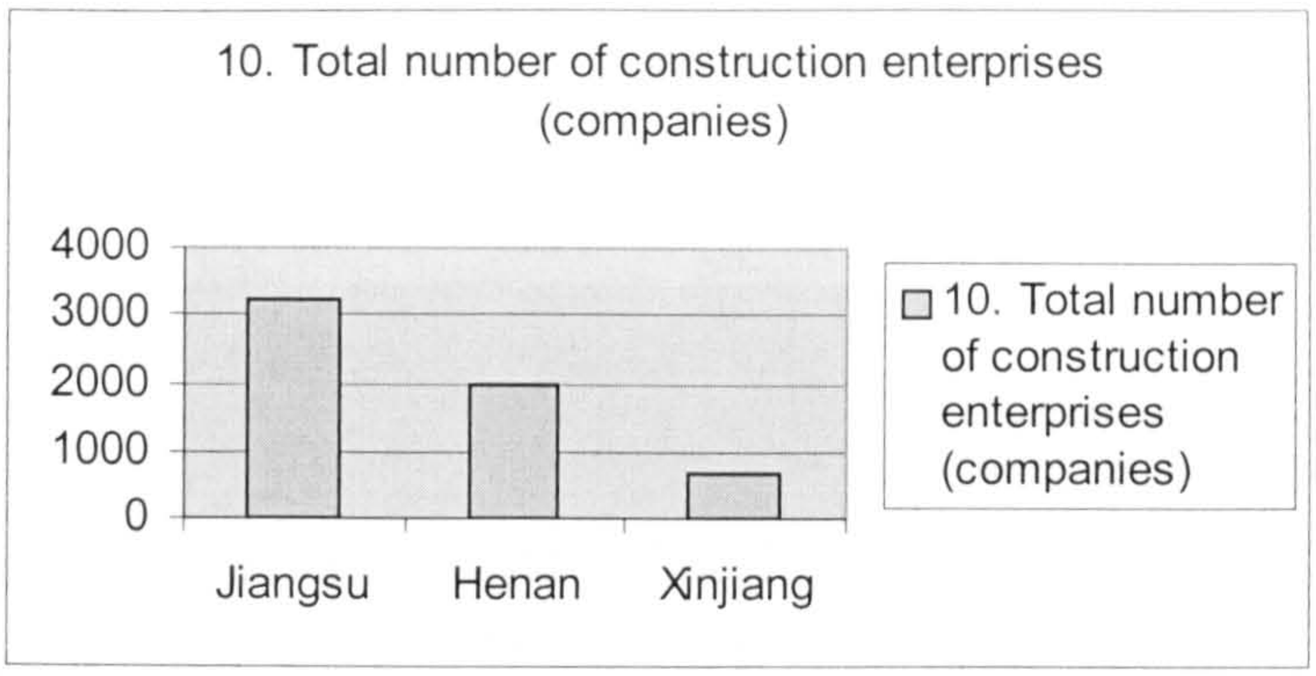


Chart 10. Total number of construction enterprises

Chart 10 shows the comparison of the total number of construction enterprises among the three regions. In fact, there is a strict classification of construction enterprises in accordance with the Regulation No. 666 (1995) promulgated by the Ministry of Construction, PRC. All the enterprises were classified as the first class, the second class, the third class and the fourth class in accordance with the personnel quality, management level, amount of capital, the ability to contract projects, technological ability, and the construction performance.

7.4.2. Main Economic Indicators in Construction Enterprises of Foreign Funded Economic Units

In order to avoid the repetition of the previous section as they have similar implication in that the first set of main economic indicators apart from that these indicators are related with foreign funded economic units, therefore, the second set of economic indicators of construction enterprises of foreign funded economic units will not be dwelled upon.

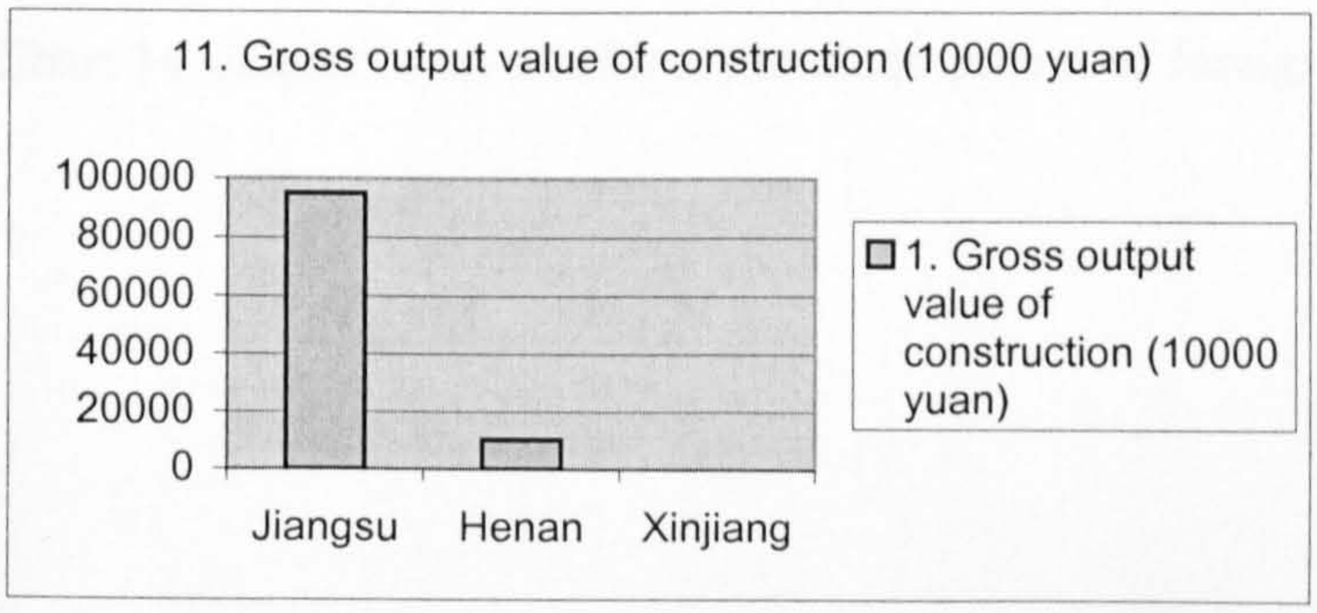


Chart 11. Gross output value of construction of foreign funded economic units

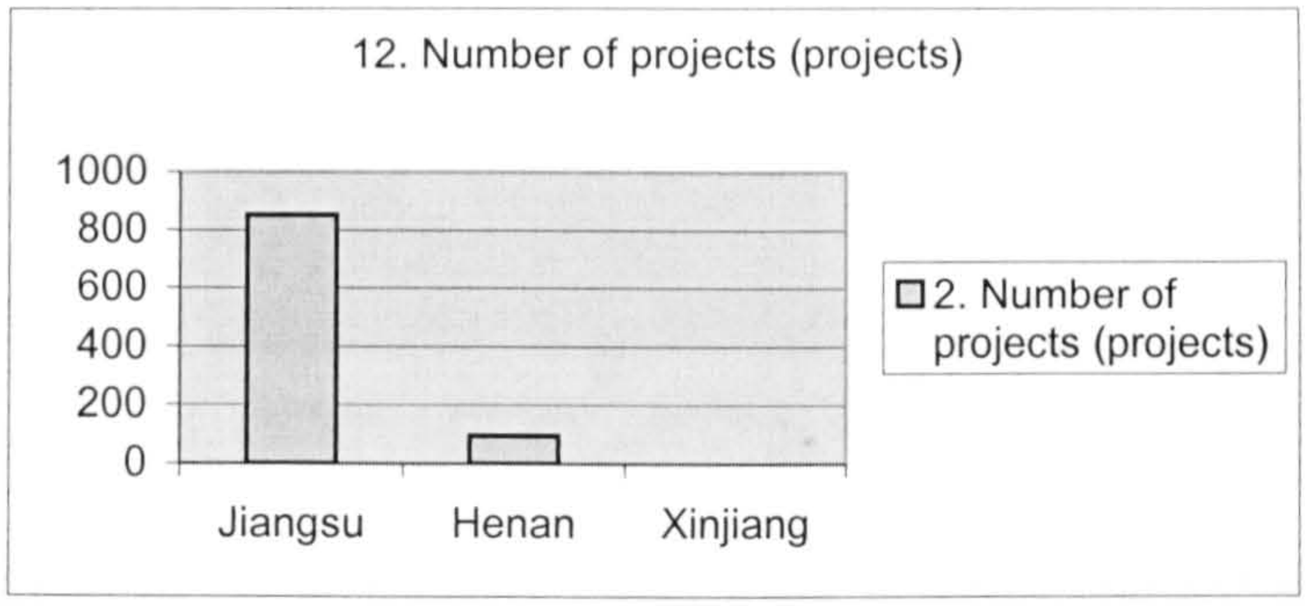


Chart 12. Number of projects of foreign funded economic units

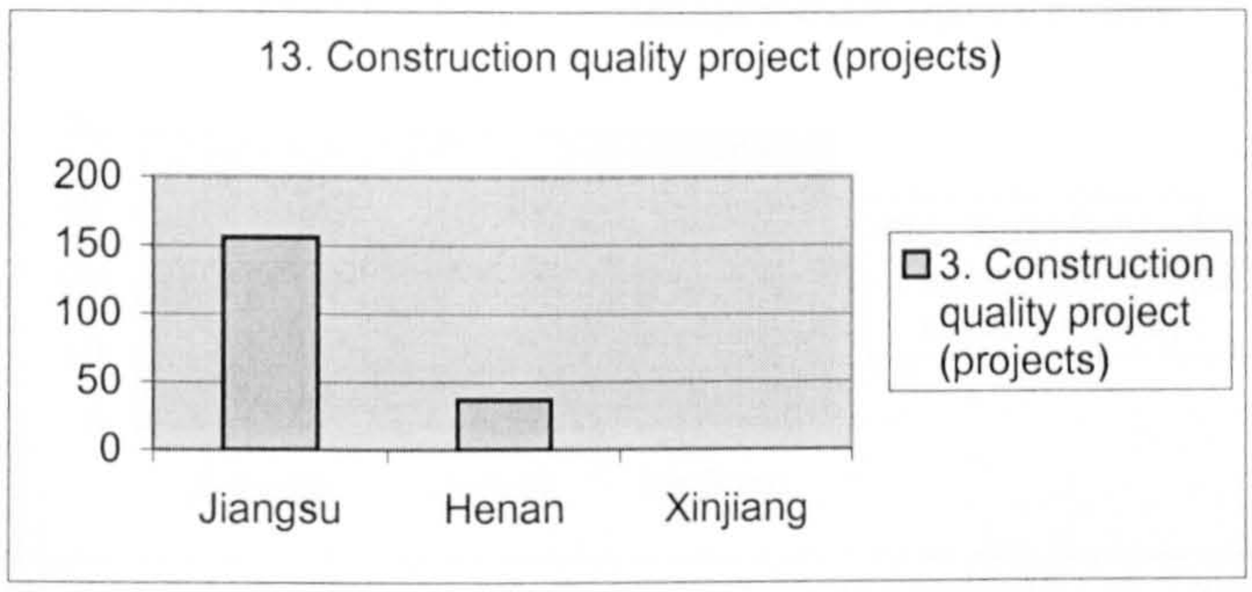


Chart 13. Construction quality project of foreign funded economic units

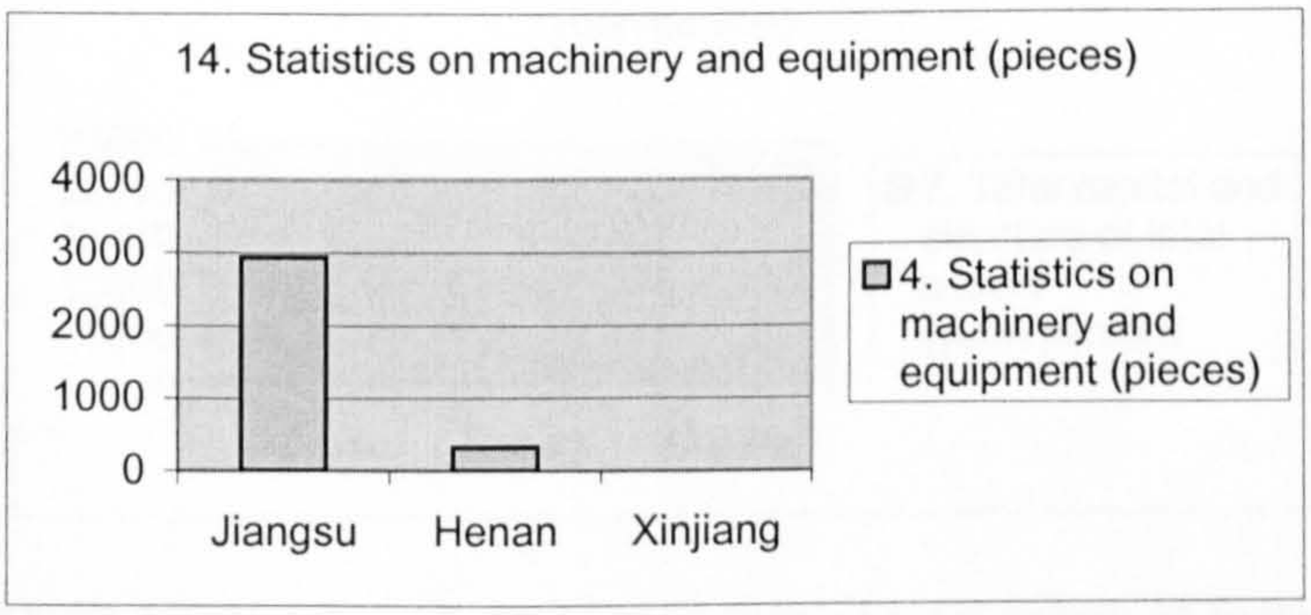


Chart 14. Statistics on machinery and equipment of foreign funded economic units

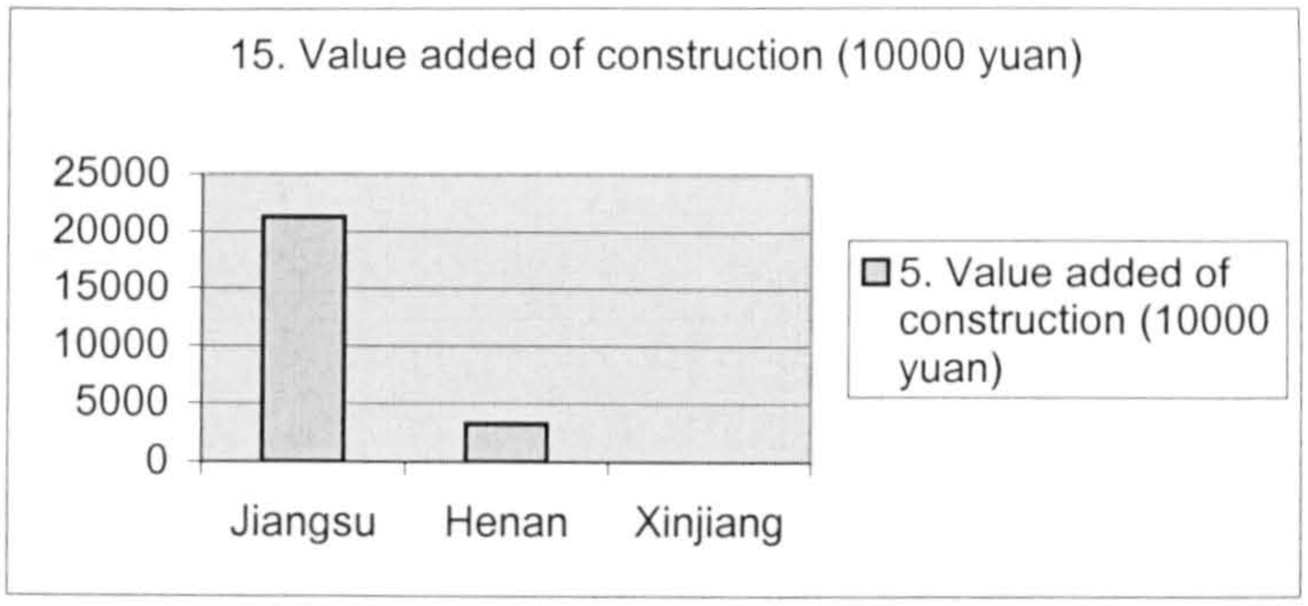


Chart 15. Value added of construction of foreign funded economic units

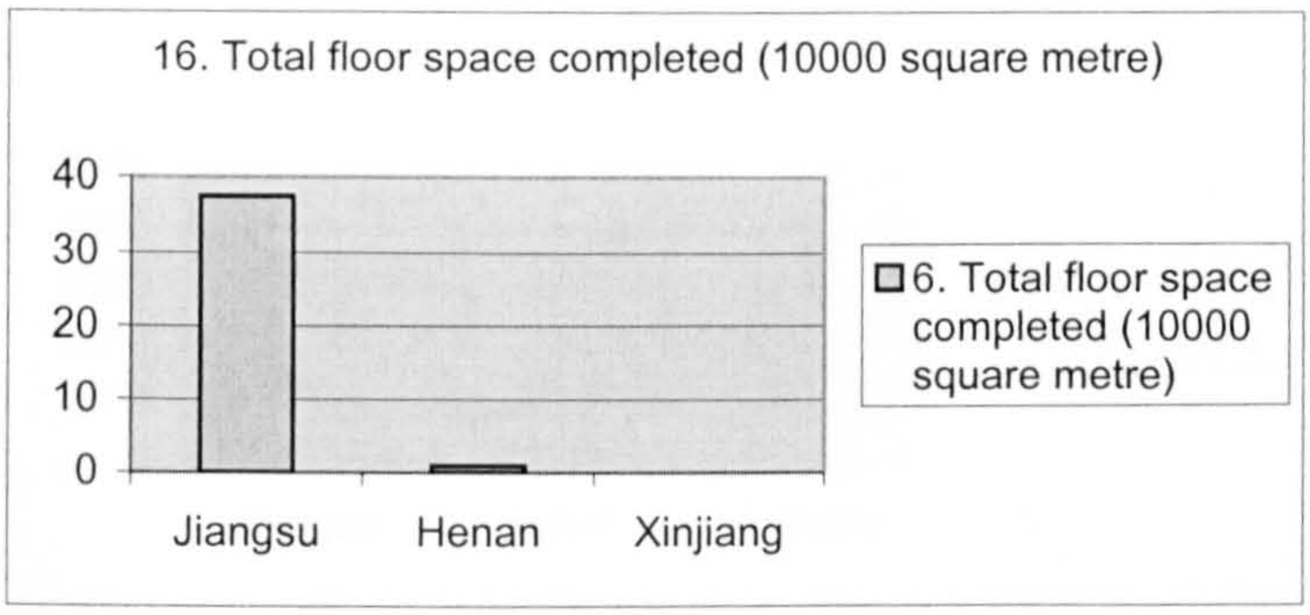


Chart 16. Total floor space completed by foreign funded economic units

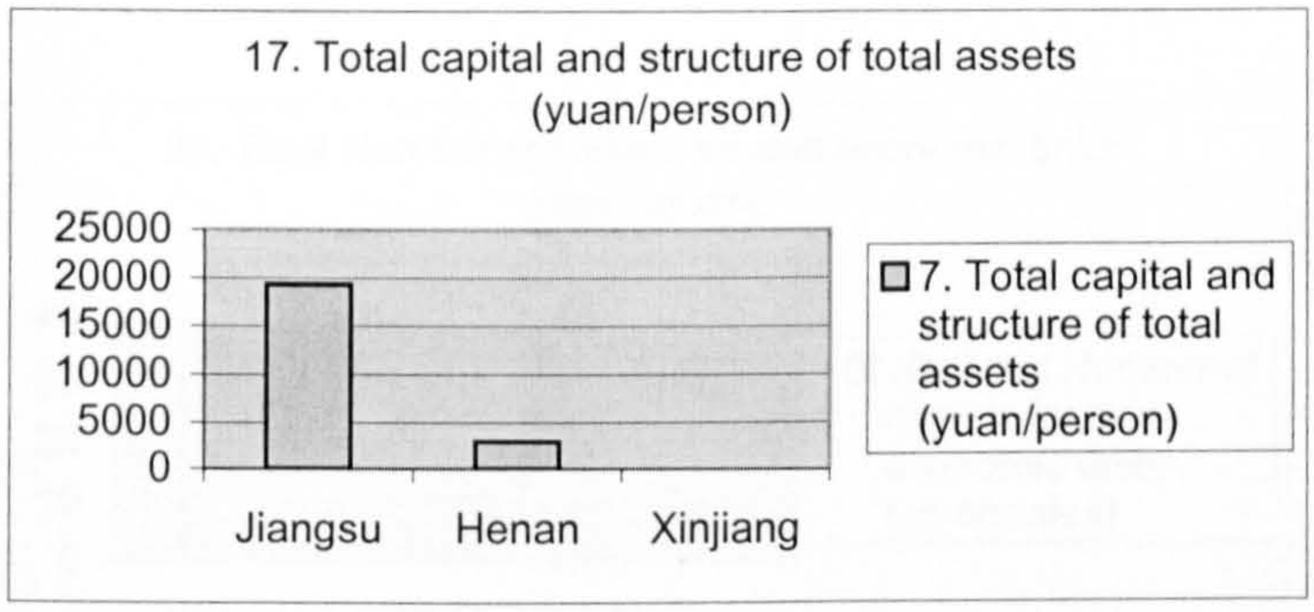


Chart 17. Total capital and structure of total assets of foreign funded economic units

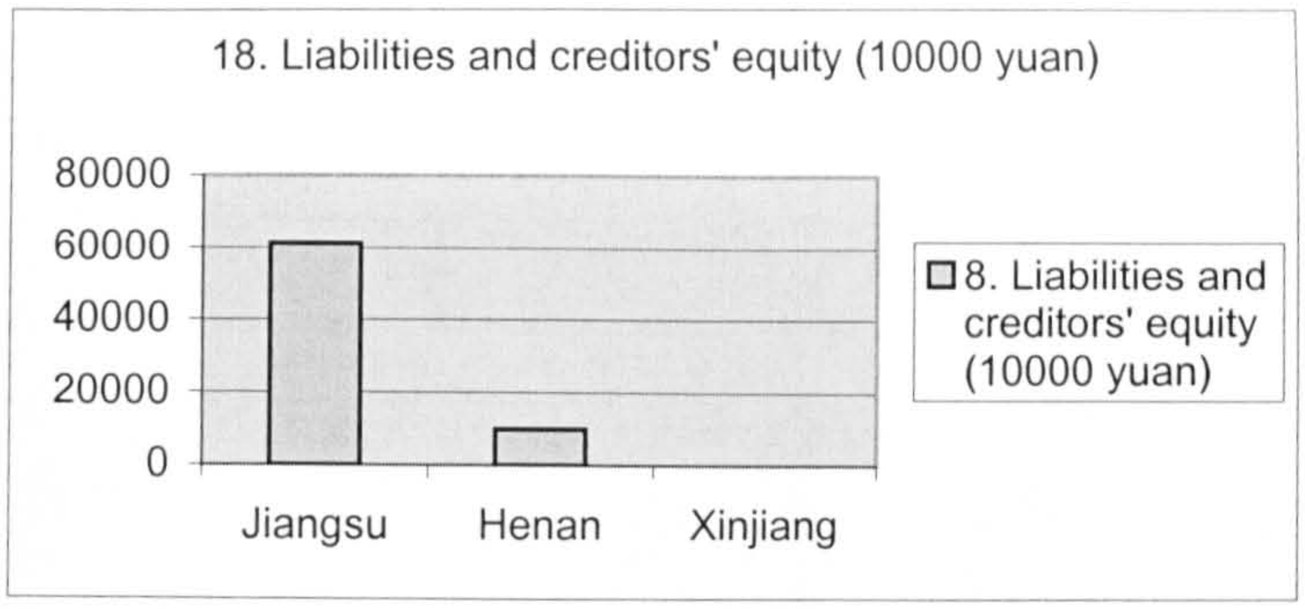


Chart 18. Liabilities and creditors' equity of foreign funded economic units

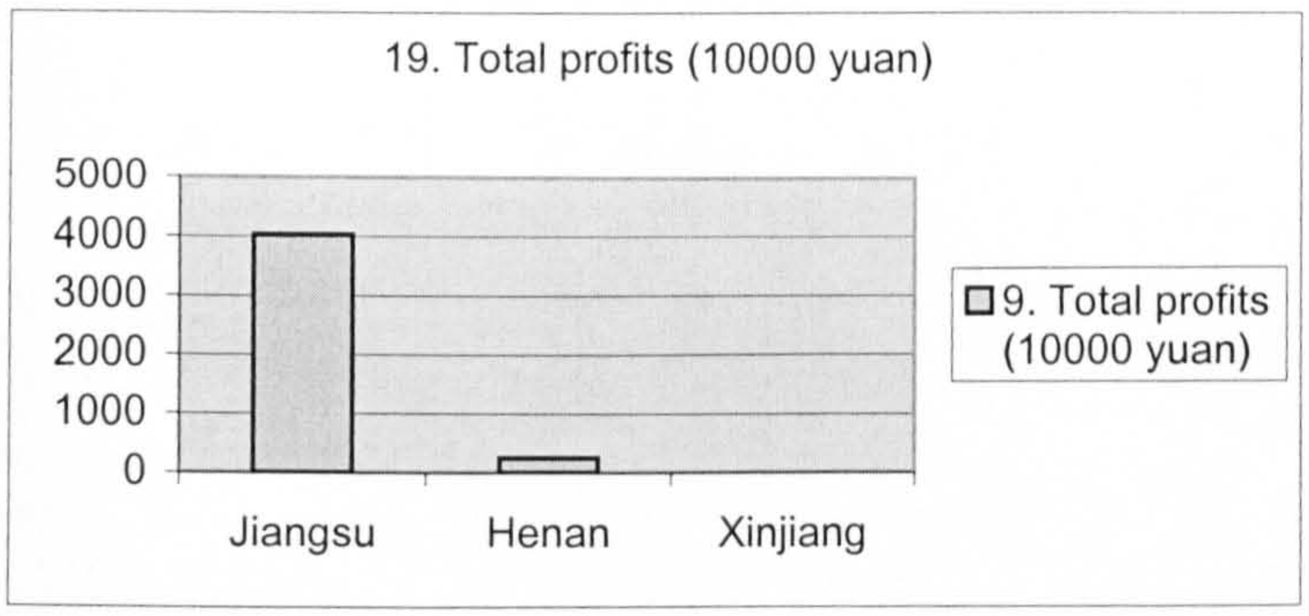


Chart 19. Total profits of foreign funded economic units

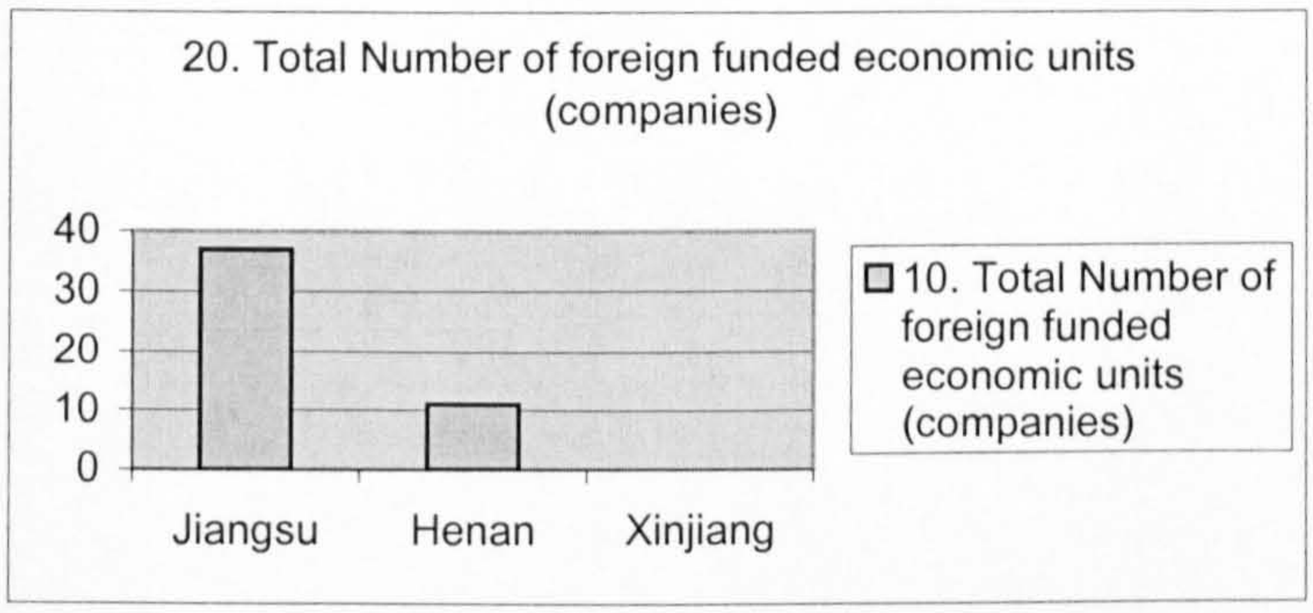


Chart 20. Total number of foreign funded economic units

7.5. Summary

Given the background of Jiangsu Province, Henan Province and Xinjiang Autonomous Region, based on the comprehensive comparison of the economic indicators of construction industry in these regions, the conclusion will be that these economic indicators in these regions mirror clearly their different development levels

in construction activity. Jiangsu Province is well-developed, Henan Province is newly-developed and Xinjing Autonomous Region is less-developed. In addition, Jiangsu Province has the feature of strong industry, Henan Province has a long history and a rich culture, while Xinjiang Autonomous Region has a feature of immigrants with a large potential to develop. In the next chapter, the discussion will focus on the discussion of the implication of these economic indicators and how they give impact to the process of knowledge transfer.

Chapter Eight

Main Study

8.1. Introduction

Following examination of the background and the reasons why Jiangsu Province, Henan Province and Xinjiang Autonomous Region were selected to be the sampling locations where the Main Study was undertaken, the chapter explains the aims and objectives of the Main Study. The view that the method statement is an important component to approach the tracking of knowledge transfer process is explained. Then, the chapter presents the results of the Main Study. Furthermore, the chapter explores the correlation between knowledge transfer and economic development, explains the implications for knowledge transfer and explains the relationships between knowledge transfer and economic development by analysing the data.

8.2. Main Study in Jiangsu, Henan and Xinjiang

As it was established previously in Chapter Five, the purpose of the Main Study in different economies is to further investigate and validate the results generated from the Pilot Study. It is believed that the Main Study, which is undertaken in a much wider context, will provide practical and fundamental indications of external validity.

The primary interest of the Main Study was to use the information collected through interviews from the Pilot Study and refine it. The results were then used to develop and establish the research model. In the Main Study, copies of a refined assessment inventory were delivered by the researcher and distributed by the construction authorities in the three chosen regions, Jiangsu Province, Henan Province and Xinjiang Autonomous Region. These three locations have been chosen because they represent different economic development levels of the construction industry in China (refer Chapter Seven). Jiangsu Province, one of the coastal and advanced provinces, has a relatively well developed construction industry while Xinjiang Autonomous Region, located in the west part of China has an industry, which is much less advanced. Henan Province, an inland province, located in the central part of China, is in the intermediate position, as was presented in the Chapter Seven. Appropriate consideration of these

factors will contribute to the understanding of the data collected and the information obtained.

8.2.1. Aims and Objectives

The aims and objectives of the Main Study are:

- To further define the process of knowledge transfer, with the establishment of the concept of tacit knowledge transfer identified during the Pilot Study;
- To refine the understanding of the process of tacit knowledge transfer based on the premises identified during the Pilot Study;
- To explore the relationship between knowledge transfer and economic development;
- To explore the relationship between explicit knowledge transfer and tacit knowledge transfer.

The study focuses on how knowledge (in particular tacit knowledge) was transferred between foreign and local managers when they completed a construction task – method statement. It is believed that the transfer of knowledge when dealing with method statements will mirror the process of problem-solving and decision-making as well as the process of knowledge transfer in the whole industry.

8.2.2. Design Rational and the Main Themes of the Assessment Inventory

The design of the Assessment Inventory for the Main Study was based on the Pilot Study of Xiaolangdi Project, in Henan Province, PRC. As has been established previously, the focus of the Main Study was to identify the process of knowledge transfer through the intimate human interaction between foreign and local managers in the joint venture organisation when they deal with the preparation and the implementation of method statements. The objective of the research was to obtain practical and useful quantitative and qualitative data through the main study. Against this background, with a consideration of pattern-matching and explanation-building when having quantitative analysis, a re-design of the Assessment Inventory of the Main Study (**see Appendix 5**) was carried out with in particular the following objectives and issues being highlighted:

1. Why a method statement is needed

Question 1 tries to explore various reasons why a method statement is needed.

2. Form of method statement

Question 2 tries to identify the form of a method statement.

3.Background to a method statement

Question 3 tries to identify the background knowledge of a method statement.

4.Further reasons for using a method statement

Question 4 tries to identify further reasons for using a method statement.

5. Authority over a method statement

Question 5 tries to identify which party has the authority to control a method statement while Question 6 tries to identify the people who are mainly involved in the process of discussing a method statement.

6. What knowledge is being transferred

Question 7 and 9 try to identify what knowledge is needed between foreign and local managers in terms of construction technology (hard knowledge or explicit knowledge) and management know-how (or soft knowledge or tacit knowledge), whereas Question 8 and 10 try to identify what knowledge were actually transferred in terms of hard knowledge and soft knowledge.

7. How knowledge transfer takes place

Question 11 and 12 try to identify the different channels of explicit and tacit knowledge transfer while Question 13 tries to identify the pattern of knowledge transfer.

8. Success of knowledge transfer

Question 14 tries to identify the influence factors of knowledge transfer, while Question 15 and Question 16 try to identify the factors in achieving a successful knowledge transfer and the motivators of knowledge transfer.

9. Critical and key issues

Question 17 tries to identify the critical and key issues of knowledge transfer in the process of construction.

10. Aftermath of knowledge transfer

Question 18, 19 and 20 try to identify the aftermath of the knowledge transfer.

8.3. Main Study Data

The results presented in this chapter are a summary of 450 copies of assessment inventory, which were returned to the researcher by the respondents from Jiangsu Province, Henan Province and Xinjiang Autonomous Region, PRC. The assessment inventory was designed both in English and Chinese. English versions were delivered to foreigners while Chinese versions were delivered to local managers with the assistance of the construction authorities in the three regions. Appendix 6 presents a summary of the receipts of the Main Study from Jiangsu Province, Henan Province and Xinjiang Autonomous region.

8.3.1. Respondents

With the help and support of the Construction Management Bureaux of Jiangsu Province, Henan Province and Xinjiang Autonomous Region, PRC, the copies of assessment inventories were distributed among joint venture companies and construction enterprises in the three regions in China. There were four hundred fifty (450) respondents from the three regions. These respondents were key personnel from within Sino-foreign joint venture companies and large-middle sized construction enterprises, who were departmental managers and engineers of the companies. Some respondents were the decision-makers of the enterprises, such as presidents, general managers, deputy general managers, chief engineers, and chief economists of joint venture companies and construction enterprises. It should be noted that consultants to the World Bank and to the Chinese Government who are working at the Xiaolangdi Project are also among the respondents. Table 8.1 shows the location and the whole sample of respondents in the Main Study.

Regions in PRC	Chinese respondents	Foreign respondents	Total in regions	Total in the Study 450
Xioalangdi	52	9	61	61
Jiangsu Province	161	-[1]	161	161
Henan Province:	128	-	128	128
Xinjiang Autonomous Region	100	-	100	100

Table 8.1. Location and whole sample of the respondents in the Main Study

8.3.2. Response Rate

A number of corresponding factors were carefully considered in order to have accurate answers from the respondents when designing the assessment inventories. Some key words, such as, ***main, mainly, principal, primary*** were highlighted in the assessment inventories. However, many respondents chose more than one answer to each question in the assessment inventories, which makes different number of the total copies of assessment inventories received and the number of total responses. Please refer to **Appendix 8** and **Appendix 9**, which shows the record of different number between the total copies of assessment inventories received and the total responses. They have been characterised as "with one answer" and "with more answers".

8.4. Interpretation of the Main Study Findings

There are 20 questions in total in the assessment inventories, which are all related with the process of knowledge transfer between foreign and local partners when dealing with the method statement. The interpretation adopts the approach that the analysis follows in order and advances step by step. Firstly the correlation between knowledge transfer and economic development by incorporating a Pearson Correlation analysis method is presented; then the summary of data collected from the three regions is explained by presenting pie charts; finally the data are discussed and analysed by linking with the correlation presented previously. Bar charts of different implications in the three different economies are presented, which provide visual aids in understanding the

[1] It has been confirmed by the construction authority of the three regions that there were efforts made to involve both foreign and local managers. However, it appears that there are no foreign respondents.

relationships between knowledge transfer and economic development among the three regions in China.

8.4.1. Exploring the Correlation between Knowledge Transfer and Economic Development

In Chapter Seven, the three geographical sources of data for the Main Study were discussed. These were the provinces of Jiangsu, Henan and Xinjiang Autonomous Region. Further, in the case of responses from Henan, a differentiation was made between those returned from the Xiaolangdi Project and 'others'. This was considered to be advisable, owing to the size and potential influence of the Xiaolangdi Project itself, and its potential for skewing the general response from Henan Province. It was considered to be potentially informative to explore the relationships between aspects of knowledge transfer and the level of economic development of each of the three geographical sources of data. To enable a more detailed analysis of the relationship between knowledge transfer and economic development, a correlation analysis was carried out with the economic indicators and the data derived from the three sample places, the measure of association adopted was Pearson's r. In order to do this, the first step was to construct a notional but valid scale of economic development. The basis of this scale was the economic data presented in Chapter Seven, in particular the ten indicators of economic development obtained from Construction Statistical Yearbook of China and presented in Table 7.2 of Chapter Seven.

1. Creation of a notional scale of economic development

The ten indicators of economic development in construction in question are shown in Table 8.1 (below).

1. Gross output value of construction (10000 yuan)
2. Number of projects (projects)
3. Construction quality projects (projects)
4. Statistics on machinery and equipment (pieces)
5. Value added of construction (10000 yuan)
6. Total floor space completed (10000 sqare metre)
7. Total capital and structure of total assets (10000 yuan)
8. Liabilities and creditors' equity (10000 yuan)
9. Total profit (10000 yuan)
10. Total number of construction enterprises (companies)

Table 8.1. Indicators of economic development

In each case, the results for Jiangsu, Henan and Xinjiang were computed as percentages of the national total figure. The resulting percentages were treated as relative development scores for each of the ten indicators, and on that basis were added to give an aggregate development score for each.

	Jiangsu	**Henan**	**Xinjiang**
1. Gross output value of construction	0.1174	0.0323	0.0125
2. Number of projects	0.0941	0.0438	0.0175
3. Construction quality projects	0.1110	0.0502	0.0129
4. Machinery and equipment	0.1001	0.0436	0.0115
5. Construction added value	0.1032	0.0313	0.0136
6. Floor space completed	0.1224	0.0387	0.0109
7. Total assets (10000 yuan)	0.0887	0.0261	0.0138
8. Investors' equity	0.1041	0.0241	0.0129
9. Total profit	0.1033	0.0237	-0.0040
10. Construction enterprises	0.0724	0.0448	0.0147
Aggregate score	**1.0168**	**0.3586**	**0.1163**

Table 8.2. Economic development scores for the three geographical data sources

For simplicity in graphical scaling, the data were then simply transformed into a 'normalised' index, with Jiangsu (raw score 1.0168) being treated as 100. This resulted in the following 'development index' for the three regions in question:

Jiangsu	Henan	Xinjiang
100	35.27	11.44

Table 8.3. Notional development index for the three geographical data sources

2. Correlation of Main Study Data with Notional Scores of Economic Development

Next, these newly created notional economic development indices for the geographical sources of data were tested for association with 19 of the 20[2] sets of responses from the main survey. For the purpose, the CORREL function in Excel was used. This function (in common with most similar statistical routines) produces a value for Pearson's *product moment correlation coefficient*, *r*. This coefficient takes values from +1 to -1 and is given by

[2] Question 1 of the inventory survey was an open question and no quantitative data resulted.

$$r = \frac{\Sigma (x_i - \bar{x})(y_i - \bar{y})}{(n-1)\, s_x\, s_v}$$

where Σx_i = sum of the variable x of all the n measurements, and

Σy_i = sum of the variable y of all the n measurements

s_x = standard deviation of x

s_y = standard deviation of y

The sign (+ or -) indicates the *direction* of the relationship (positive or negative), and the number indicates the strength of the relationship. In the following analysis, values less than 0.3 have been described as 'weak'; between 0.3 and 0.5 as 'moderate'; 0.5 and 0.6 as significant, and 0.7 and above as 'strong'. The results of the correlation are shown in Table 8.4. (below).

		Jiangsu	**Henan**	**Xinjiang**	Pearson 's r	**Comment**
How did you communicate method statement?	Formal document	65.64%	42.61%	41.58%	0.975	Strong +ve
	Sketch or note	19.63%	56.52%	32.67%	-0.578	Significant -ve
	Verbal	14.72%	0.87%	25.74%	-0.196	Weak -ve
Form of method statement	Handbook	22.44%	14.81%	9.00%	0.983	Strong +ve
	Previous MS	16.67%	16.10%	25.00%	-0.667	Significant -ve
	Contract document	55.77%	53.00%	45.00%	0.861	Strong +ve
	Handmade	5.13%	16.10%	21.00%	-0.999	Strong -ve
Main reason	Task Complex	18.52%	3.74%	4.00%	0.961	Strong +ve
	Resources	36.42%	33.64%	51.00%	-0.595	Significant-ve
	Work guidance	25.93%	11.21%	17.00%	0.788	Strong +ve
	Required by client	19.14%	51.40%	28.00%	-0.505	Significant -ve
Which party had the final say	Local	16.97%	4.58%	22.00%	-0.024	Weak -ve
	Foreign	24.85%	3.05%	30.00%	0.079	Weak +ve
	Together	58.18%	58.00%	48.00%	0.719	Strong +ve
Which party was mainly involved	Local	7.83%	30.75%	13.27%	-0.470	Moderate -ve
	Foreign	16.87%	12.25%	30.61%	-0.516	Significant -ve
	Together	75.30%	57.00%	56.12%	0.975	Strong +ve
Main needed knowledge	Cnstr. technology	16.56%	15.79%	30.69%	-0.675	Significant -ve
	Mgnt know-how	83.44%	84.21%	69.31%	0.675	Significant +ve
Main actual knowledge	Cnstr. technology	33.12%	33.70%	31.31%	0.524	Moderate +ve
	Mngt know-how	66.88%	66.30%	68.69%	-0.524	Moderate -ve

Main needed knowledge	Explicit	33.77%	68.22%	50.98%	-0.706	Strong -ve
	Tacit	66.23%	31.78%	49.02%	0.706	Strong +ve
Main actual knowledge	Explicit	48.08%	51.64%	46.32%	0.071	Weak +ve
	Tacit	51.92%	48.36%	53.68%	-0.070	Weak -ve
Main channel (explicit knowledge)	Conferences	29.80%	20.18%	30.61%	0.190	Weak +ve
	Meetings	30.46%	53.51%	13.27%	0.178	Weak +ve
	Seminars	27.81%	14.04%	50.00%	-0.387	Moderate -ve
	Training	11.92%	12.28%	6.12%	0.670	Significant +ve
Main channel (tacit knowledge)	Job training	17.86%	40.00%	12.12%	-0.064	Weak -ve
	Telephone	22.14%	19.23%	22.22%	0.235	Weak +ve
	Social	39.29%	20.51%	53.54%	-0.183	Weak -ve
	Chance meeting	20.71%	20.26%	12.12%	0.740	Strong +ve
Principal pattern of transfer	Foreign - local	28.66%	53.85%	28.28%	-0.245	Weak -ve
	Local - foreign	14.63%	7.69%	33.33%	-0.498	Moderate -ve
	2- way process	56.71%	38.46%	38.38%	0.967	Strong +ve
Main influencing factor	Culture	9.93%	13.33%	32.32%	-0.800	Strong -ve
	Language	30.46%	75.83%	25.25%	-0.166	Weak -ve
	Common objective	36.42%	5.00%	14.14%	0.853	Strong +ve
	Social values	23.18%	5.83%	28.28%	0.042	Weak +ve
Primary success factor	Mutual respect	18.13%	35.65%	35.42%	-0.962	Strong -ve
	Co-operation	60.63%	46.96%	48.96%	0.921	Strong +ve
	Co-ordination	21.25%	17.39%	15.63%	0.999	Strong +ve
Principal motivator	Mutual benefit	44.74%	24.37%	40.00%	0.466	Moderate +ve
	Collaboration	41.45%	24.37%	36.15%	0.538	Significant +ve
	Complete task	13.82%	51.26%	23.85%	-0.499	Moderate -ve
Principal issue resolved	Time	11.69%	2.88%	5.05%	0.877	Strong +ve
	Cost	22.08%	17.31%	23.23%	0.076	Weak +ve
	Safety	28.57%	36.54%	35.35%	-0.921	Strong -ve
	Quality	37.66%	43.27%	36.36%	-0.083	Weak -ve
Action with method statement after	Implemented	13.33%	17.05%	21.00%	-0.962	Strong -ve
	Revised	83.64%	61.24%	69.00%	0.819	Strong +ve
	Rejected	3.03%	21.71%	10.00%	-0.596	Significant-ve
If revised or rejected how resolved	By the local	18.29%	10.75%	12.63%	0.875	Strong +ve
	By foreigner	15.24%	14.55%	28.42%	-0.676	Significant -ve
	Compromise	61.59%	55.00%	48.42%	0.966	Strong +ve
	By third party	4.88%	19.70%	10.53%	-0.603	Significant -ve
Work carried out...	Normally	29.88%	34.88%	29.00%	-0.122	Weak -ve
	Better	70.12%	65.12%	71.00%	0.122	Weak +ve

Table 8.4. The correlation between knowledge transfer and economic development in Jiangsu, Henan and Xinjiang, PRC

There follows a step by step interpretation and analysis of the findings. Table 8.4. indicates a number of correlation between aspects of knowledge transfer and economic development in Jiangsu, Henan and Xinjiang. According to the correlation results shown in Table 8.4, the relationship between certain aspects of knowledge transfer and economic development can be predicated.

8.4.2. Explaining the Implications for Knowledge Transfer

In accordance with the sequences and natures of the questions, given the analytical strategy of pattern-matching and explanation-building, ten major themes together with the implication for knowledge transfer are presented as follows:

1. Why is the Method Statement Needed

In the main study, this theme is a starting point, left with an open answer, which is used to collect various opinions towards using a method statement. It should be noted that almost all of the respondents in the three regions returned the assessment inventories without answering this question. Fortunately a majority of the respondents in the Xiaolangdi Project answered this question. 45% of the 61 respondents returned the assessment inventories without answer. However, 55% of the 61 respondents replied with answers. Some even wrote a paragraph to express the reasons why the construction method statement was needed. The analysis suggests that there are two categories of answers. One category is functional (F), the other is administrative (A). Table 8.2 shows the briefing record of various key reasons that the respondents provided, which have been categorised as "F" and "A".

Table 8.2. Key answers to Question 1 in the Assessment Inventory

Question: Why did you need to determine the method statement?	**Functional**	**Administrative**
Key Answers:		
"Method statement is important to guarantee quality, time and cost of the project".	F	
"This is in accordance with requirement of the contract".		A
"This is in accordance with IS09001".		A
"Method statement is very effective".	F	
"Method statement is needed for the resource allocation".	F	

"This is for the satisfaction of the client".		A
"*For health and safety*".		A
"*It helps to solve construction problems*".	F	
"*For the administration of the contract*".		A
(Please note that the following answers are provided by respondents who gave their titles and positions as they are recorded).		
"Nothing cannot be done properly without method statement". – A Senior Engineer and PhD candidate	F	
"*Using method statement can clarify aims and responsibilities of both parties so that the task can be completed with high quality".* – A Senior Engineer	F	
"Method statement is the best way to solve various problems, improve productivity and make up the shortcomings of the original plan". - Project Manager	F	
"Method statement is a way to shorten the time of completion, to guarantee the quality and improve logistic management". – An Engineer		A
"The speciality of project investment requires the use of method statement". – An Engineer	F	
"*Method statement is an effective way to combine technology and management*". – An Engineer	F	
"*Method statement agrees with natural law*". – An Engineer	F	
"*To ensure that the work is carried out orderly, efficiently and safely*". – Head Consultant, Adviser and Engineer	F	
"To organise a repetitive task in a consistent manner". – A Planning Adviser	F	
"*Using method statement is mandatory*". – A Project Service Engineer		
"*To satisfy the contractual requirements and in order to carry out the work".* – Manager of Hydro-Mechanical Department	F	
"*Method statement is one of the most important document of the construction, which has a big influence on quality, organisation and cost*". - Manager of Work Department		A
		A

2. Form of the Method Statement

As regards with the form of method statement, 3 choices in the assessment inventory were provided. They are "formal document", "sketch or note" and "verbal". Among the total of 450 responses, 55.81% confirmed that "formal documents" were used to communicate the method statement. "Sketch or note" and "verbal" account for 31.89% and 12.30% respectively. This result implies that construction people prefer "formal document rather than the informal means of communication. Chart 2 represents these different implications.

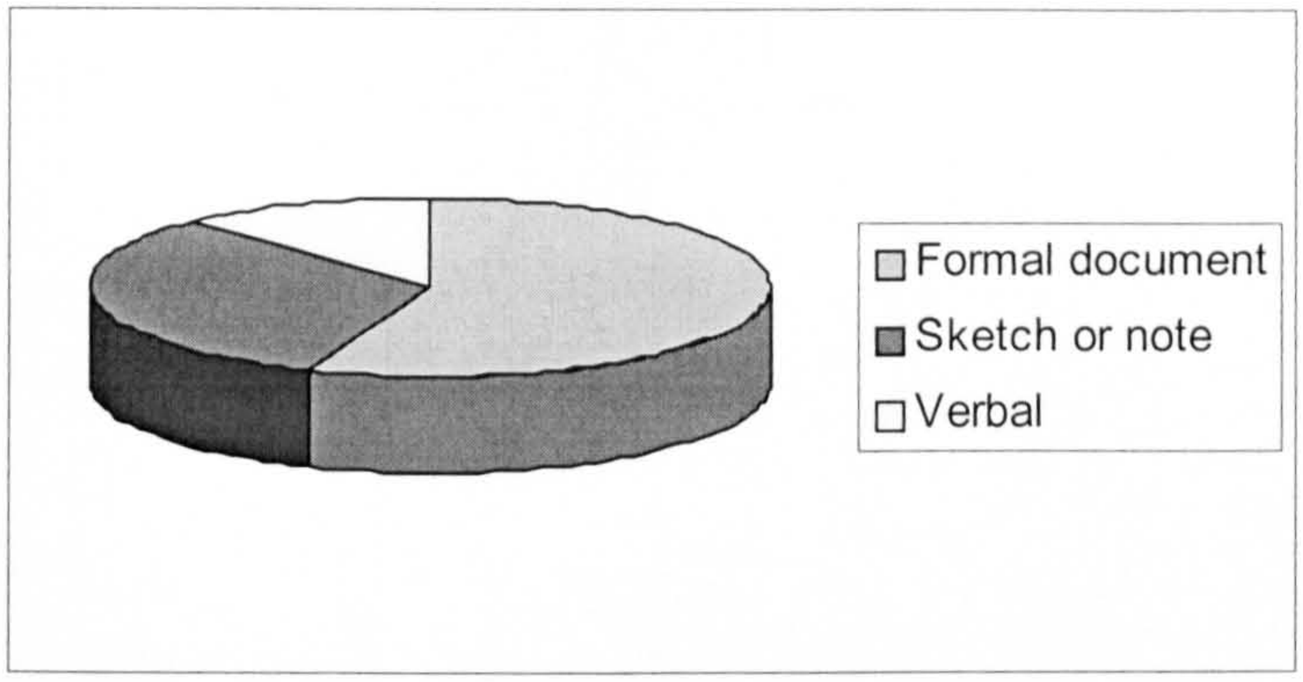
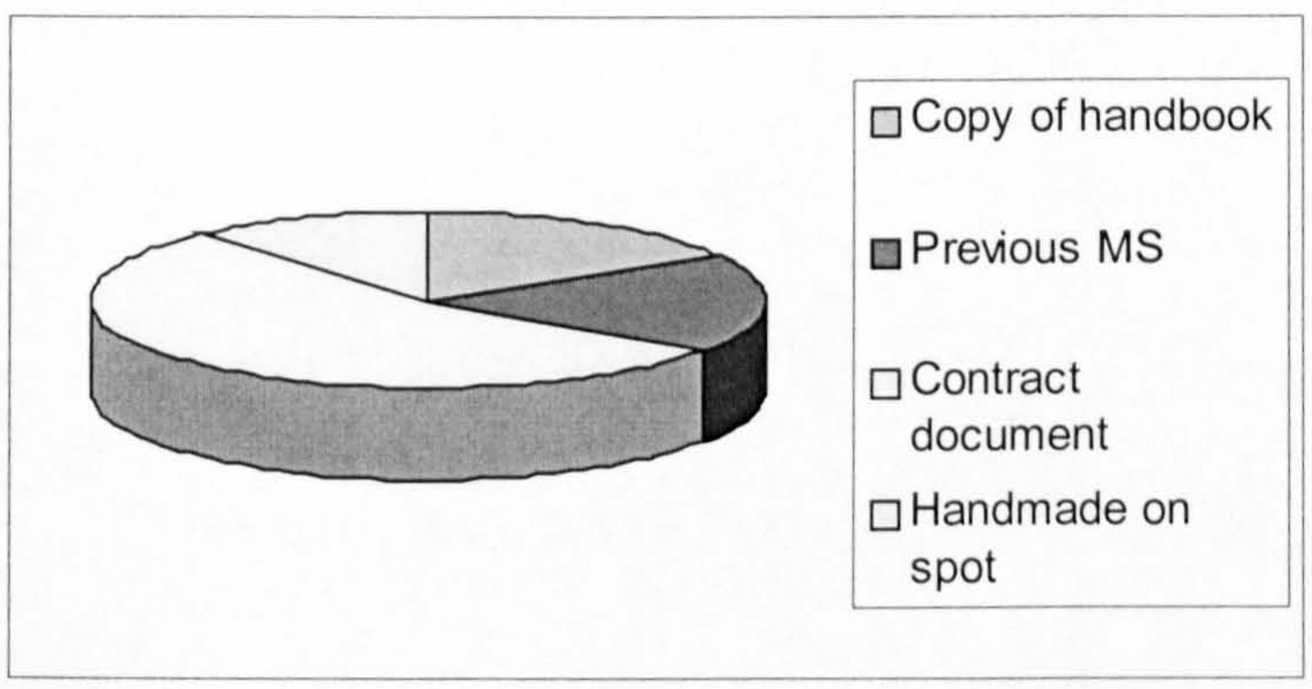


Chart 2. Form of method statement

3. Foundation of the Method Statement



In terms of foundation of method statement, 53.37% of responses in the study responded that the form of method statement was mainly based upon "contract document" while "copy of handbook" accounts for 16.59%, "previous MS" accounts for 18.27% and "handmade on spot" accounts for 11.54% respectively. This result implies that construction people suggest that method statement should be an integral part of the contract document. Chart 3. Foundation of method statement

4. Further Reasons of Using Method Statement

It is controversial that the respondents in the three regions hold different views towards the further reasons of using method statement. "Complicated task" accounts for 9.62%, "resource allocation" accounts for 37.36%, "guidance of work" accounts for 17.90% and "required by client" accounts for 35.12% respectively. Chart 4 shows the different views about this issue.

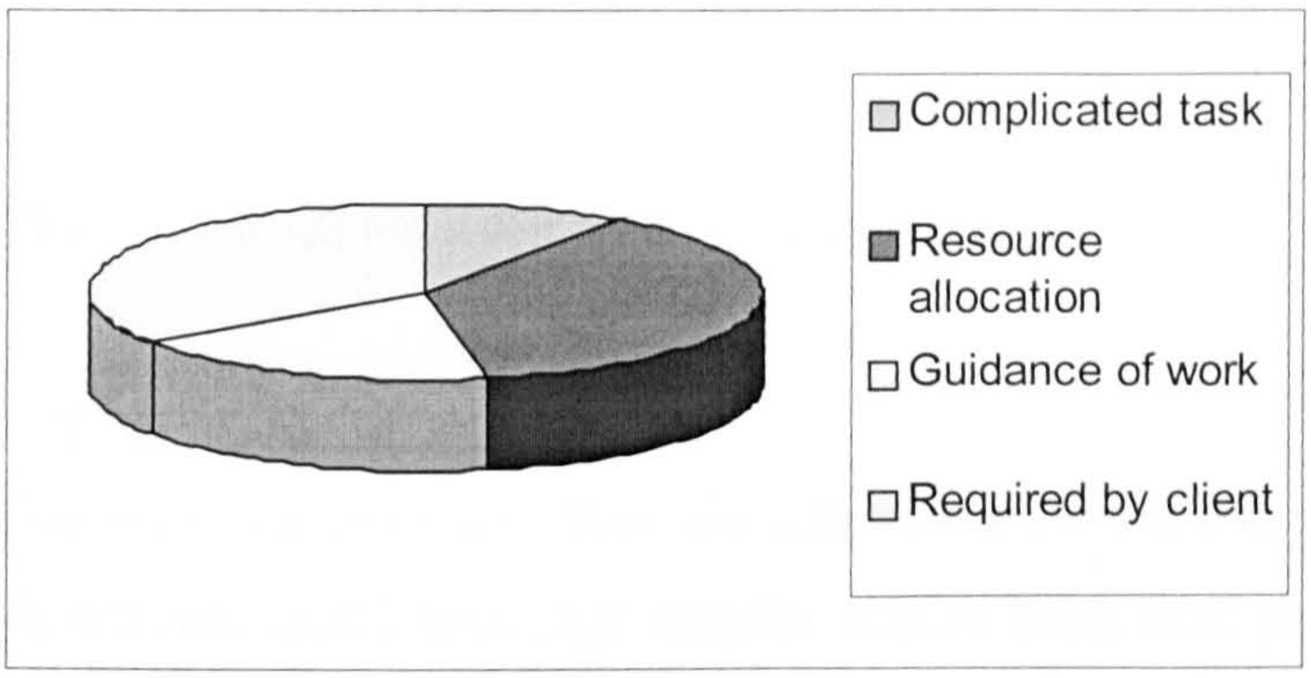


Chart 4. Further reasons of using method statement

5. Authority over Method Statement

In terms of which party has the control over the method statement issue, 59.21% of the responses confirmed that the foreign and local partners should work "together" closely and make decision "together" whereas 18.34% of the responses still favour "local" partner and 22.34% of the responses still favour "foreign" partner.

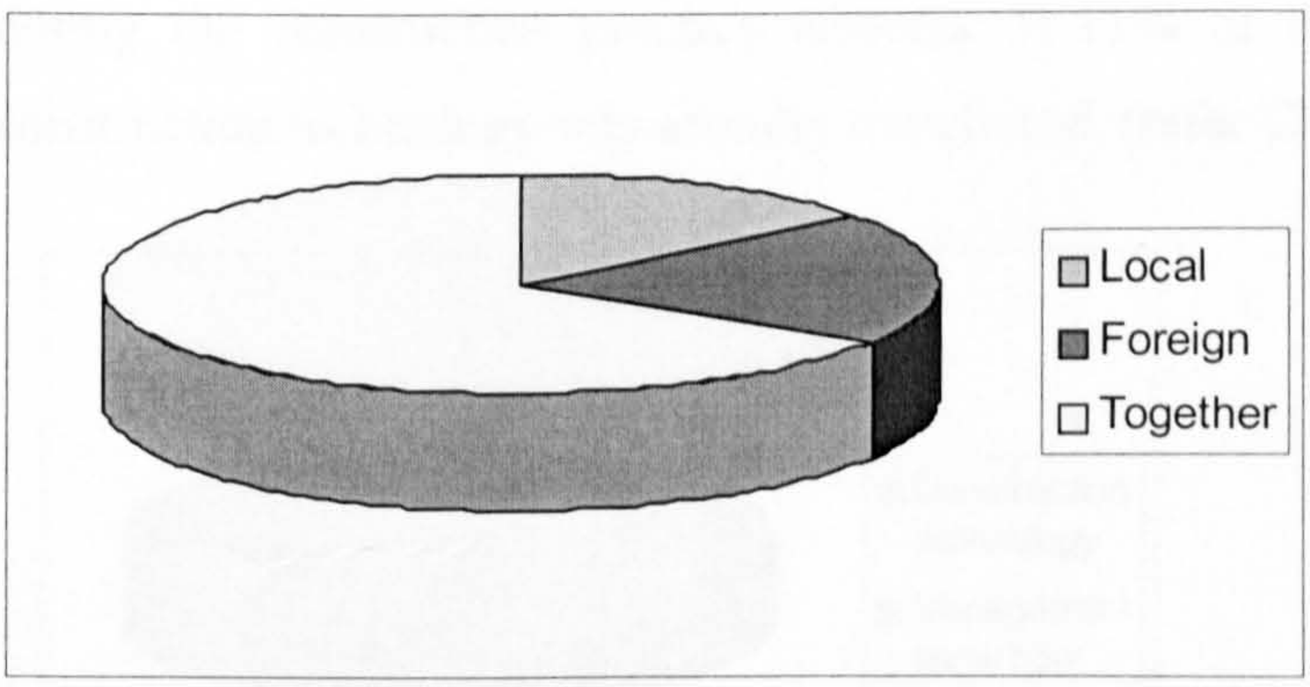


Chart 5. Authority over Method Statement

6. Parties Involved with Method Statement

It seems necessary for both the foreign and local partners to always discuss method statements together and solve the problems together. In the study, 67.61% of the responses confirmed the issue whereas 14.35% of the responses still favour "local" partner and 16.74% of the responses still favour "foreign" partner.

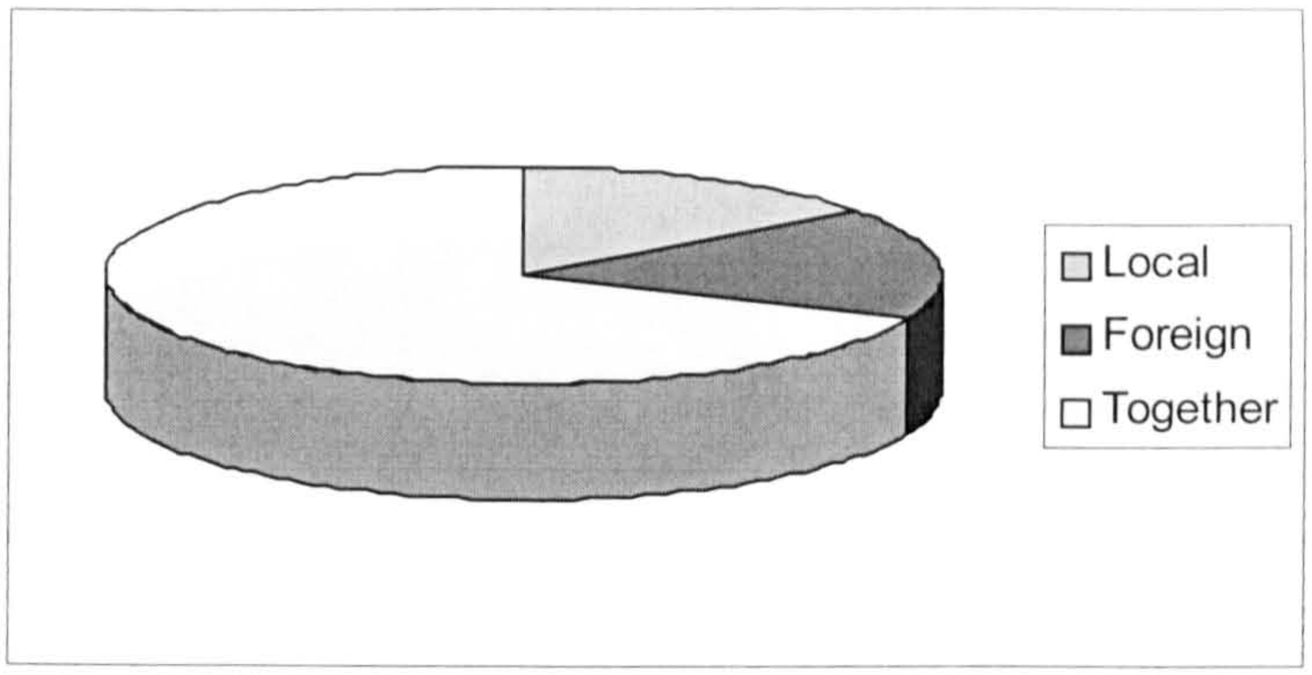


Chart 6. Parties involved with method statement

7. What Is Being Transferred

The empirical evidence from the interviews carried out on the Xiaolangdi Project has shown that tacit knowledge transfer occurs from time to time during the execution of the project between members of management pairs composed a foreign (F) and a local (L) manager. The data collected in the main study has further confirmed the transfer of tacit knowledge, (management know-how). In the study, 80.28% of the responses confirmed that management know-how needed to transfer in construction, whereas 19.72% of the responses confirmed that construction technology needed to transfer between foreign and local partners. In the study, 68.66% of responses confirmed that management know-how was actually transferred between foreign and local partners during the construction practice whereas 31.11% of the responses confirmed that construction technology was actually transferred. (refer Chart 7 and Chart 8).

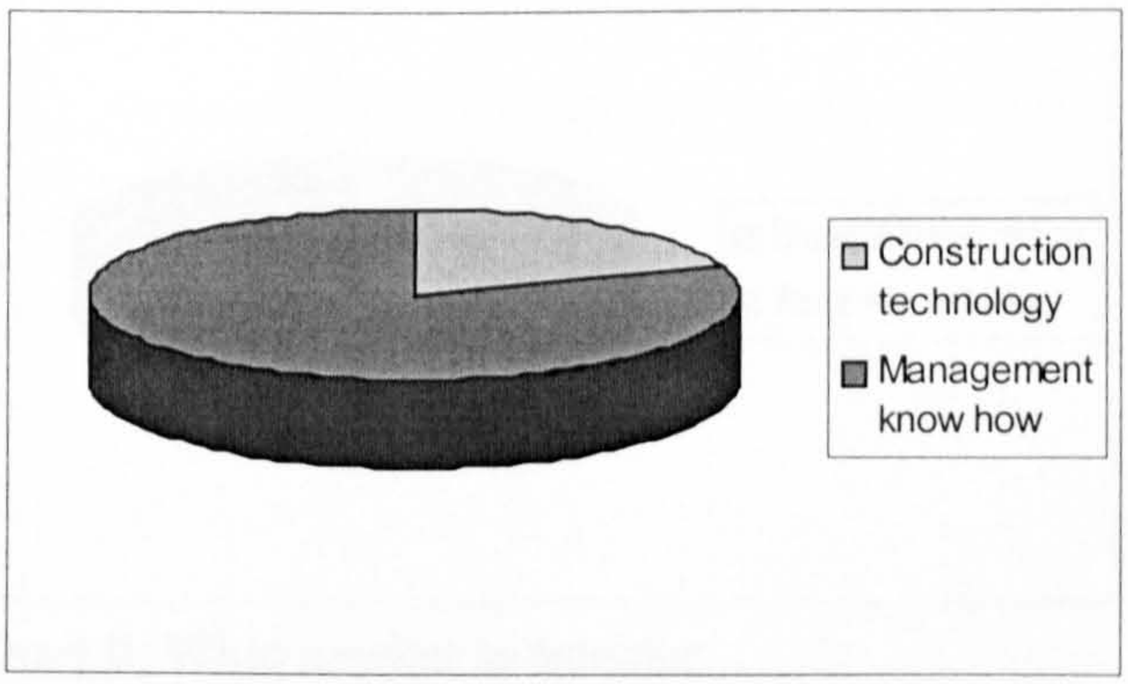


Chart 7. What needed to be transferred

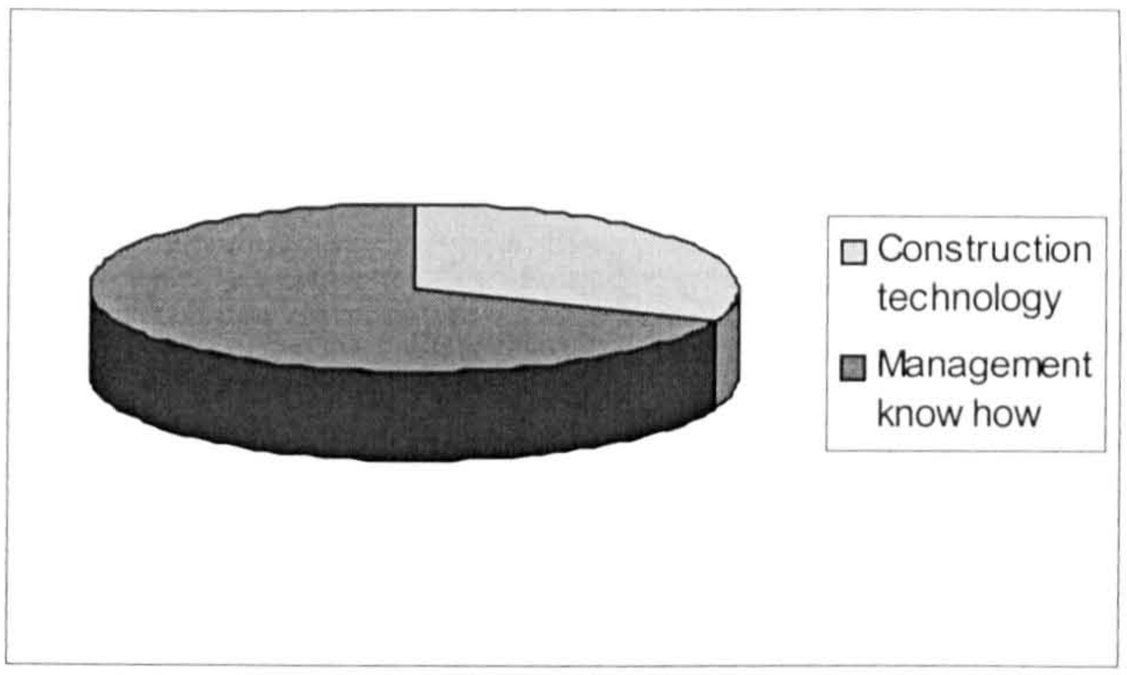


Chart8. What was actually transferred in practice.

8. Explicit Knowledge or Tacit Knowledge

It should be noted that this theme is similar to the last theme. The repetition was used as a check on the respondents' s understanding. It was apparent that the respondents had no clear understanding of "explicit" knowledge and "tacit" knowledge.

In the main study, 53.18% of responses confirmed that tacit knowledge needed to transfer between foreign and local partners during the construction practice whereas 53.99% of the responses confirmed that it was tacit knowledge that was actually transferred. Chart 9 shows that tacit knowledge transfer dominates the question "what needed to transfer" while Chart 10 shows that tacit knowledge transfer again dominated the question "what actually did transfer".

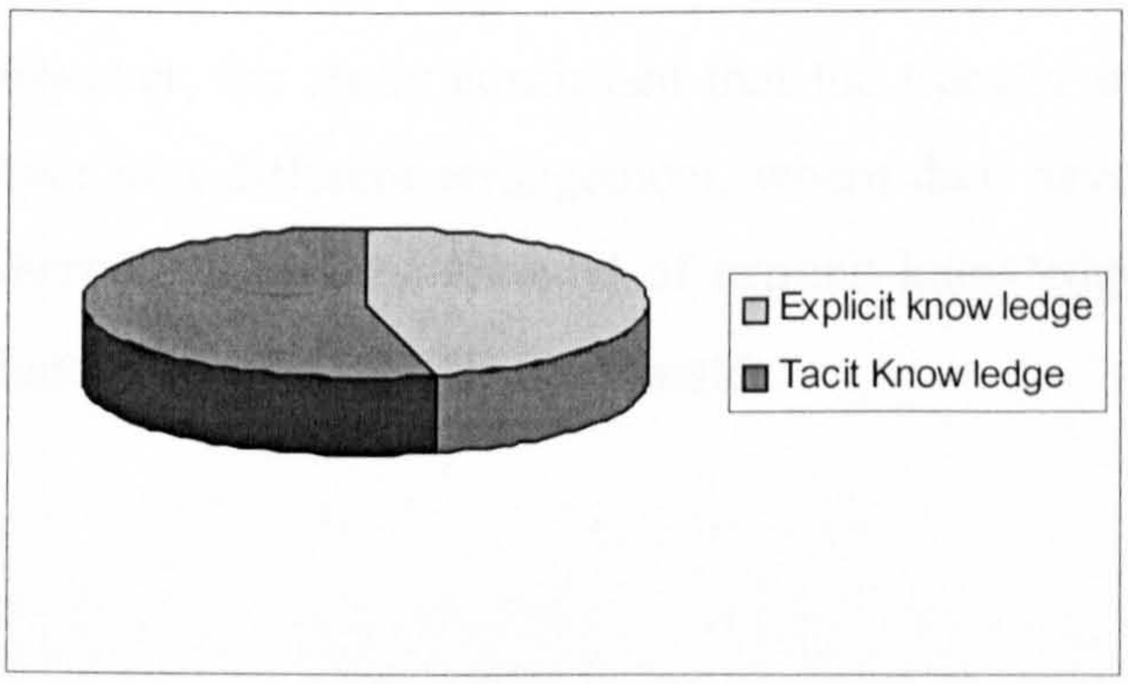


Chart 9. What needed to transfer.

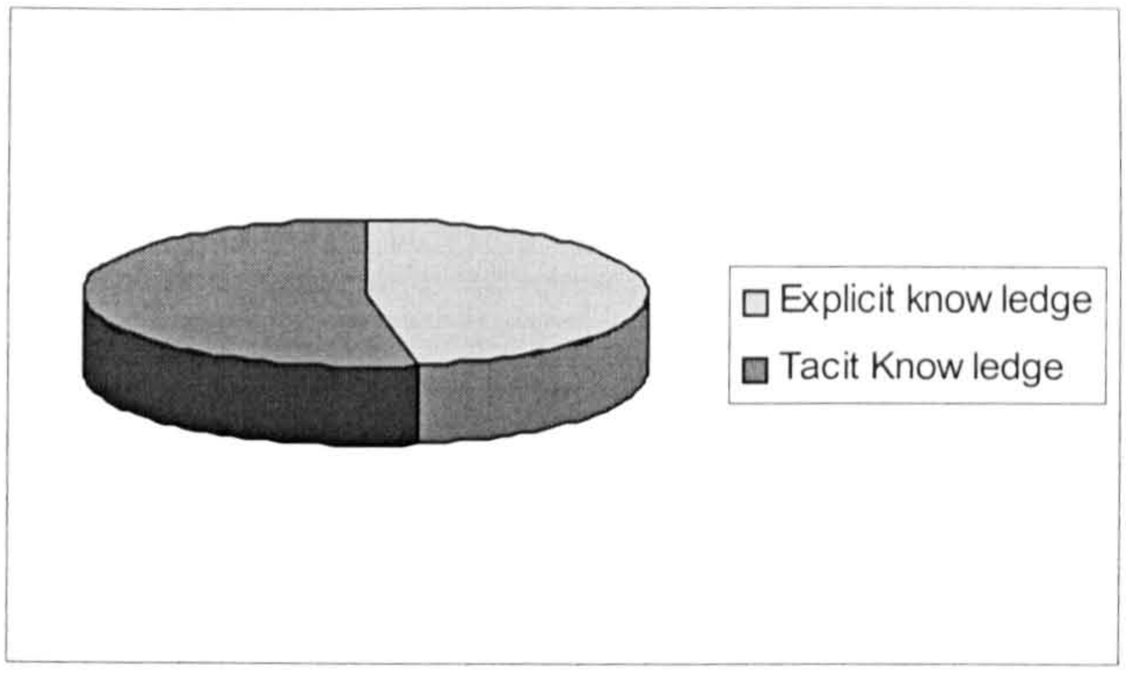


Chart 10. What actually did transfer.

9. How Was Knowledge Transferred

The study has shown that explicit knowledge is in general transferred through formal means, such as conferences, meetings, seminars and training sessions while tacit knowledge is transferred through informal means, such as, on the job training, telephonic communication, social occasions and chance meetings. In the design of the assessment inventory, the intention was to know the main channels for both the explicit and tacit transfer, but it seems that there is no clear trend to distinguish which channel is the main channel. "Conferences" accounts for 29.95%, "meetings" accounts for 33.33%, "seminars" accounts for 27.54% and "training sessions" account for 10.39%. "Job training" account for 24.44%, "telephonic communication" account for 20.49%, "social occasions" account for 35.80% and "chance meetings" account for 18.17%. However, the study confirmed that the transfer of explicit and tacit knowledge takes place in a different arrangement, where they have their own special ways of transfer. Chart 11 shows the channel of explicit knowledge transfer while Chart 12 shows the channel of tacit knowledge transfer.

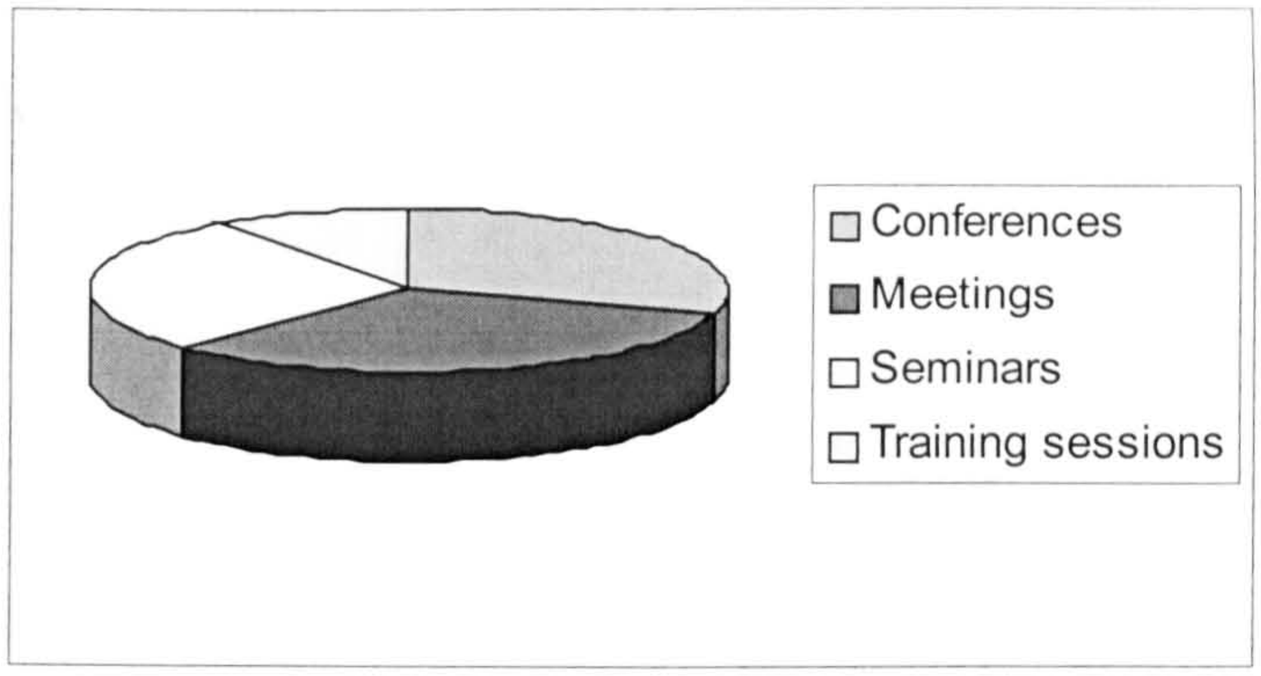


Chart 11. Channels of explicit knowledge transfer

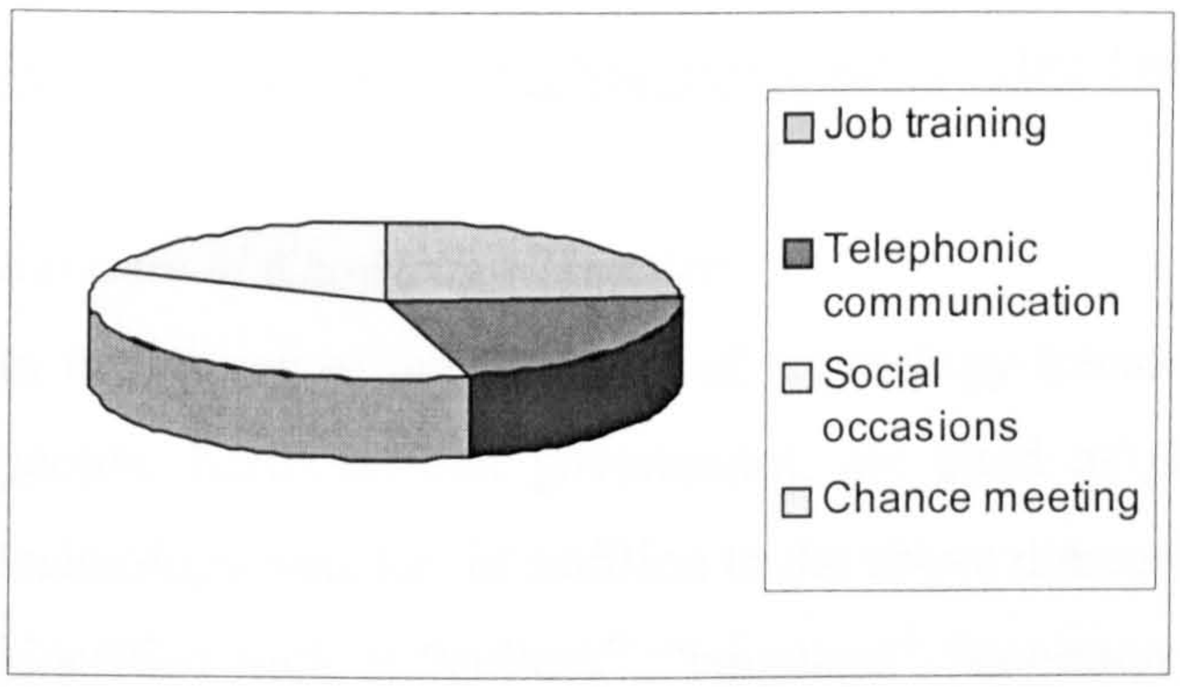


Chart 12. Channels of tacit knowledge transfer

Given the dimension and channels for knowledge transfer, the study discovers that explicit knowledge is often transferred through well-structured written document while tacit knowledge is transferred when the message is passed by. However, it should be noted that 51.32% of the responses of foreign and local managers confirmed that knowledge transfer in particular in terms of management know-how is a "two-way process" between multinational and local partners, while 33.48% of the responses believe that knowledge transfer is one way from foreign to local and while 15.20% of the responses believe that knowledge transfer is one way from local to foreign. Chart 13 shows that “a two-way process of knowledge transfer” dominates the process of knowledge transfer.

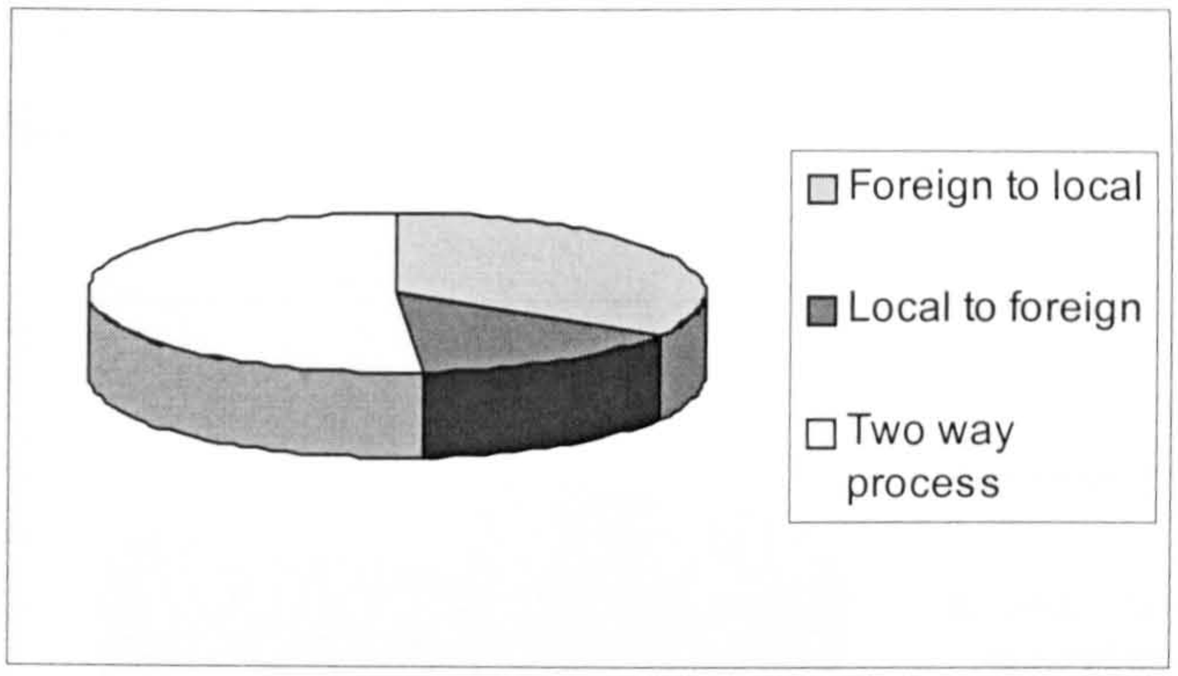


Chart 13. Patterns of knowledge transfer

10. Factors in Achieving Successful Knowledge Transfer

Barriers of Knowledge Transfer

In the survey of the literature of technology transfer, many factors, such as economy, people, business, and government, are cited as potential barriers to the success of technology transfer. In addition to the above dimension, the other factors that have been identified such as "culture", "language", "common objective" and "social value" give significant impact to the process of knowledge transfer. However, "culture" accounts for 18.31%, "language" accounts for 40.85%, "common objective" accounts for 21.36% and "social value" accounts for 19.48%. Chart 14 shows the barriers of knowledge transfer.

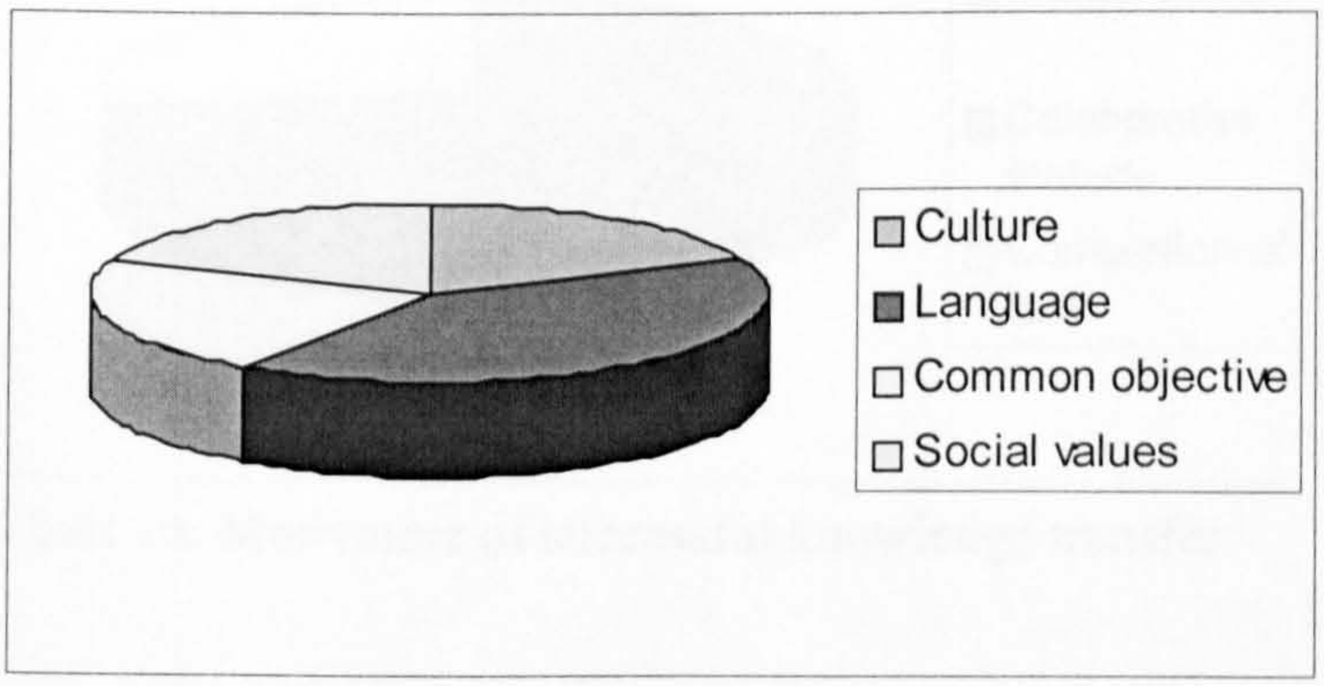


Chart 14. Barriers of knowledge transfer

Factors of successful knowledge transfer

In terms of the factors in achieving a successful knowledge transfer, 28.87% 0f the respondents have chosen "mutual respect", 54.46% of the respondents have chosen

"close co-operation while 16.67% have chosen "appropriate co-ordination" in the Main Study. Chart 15 shows the factors of successful knowledge transfer.

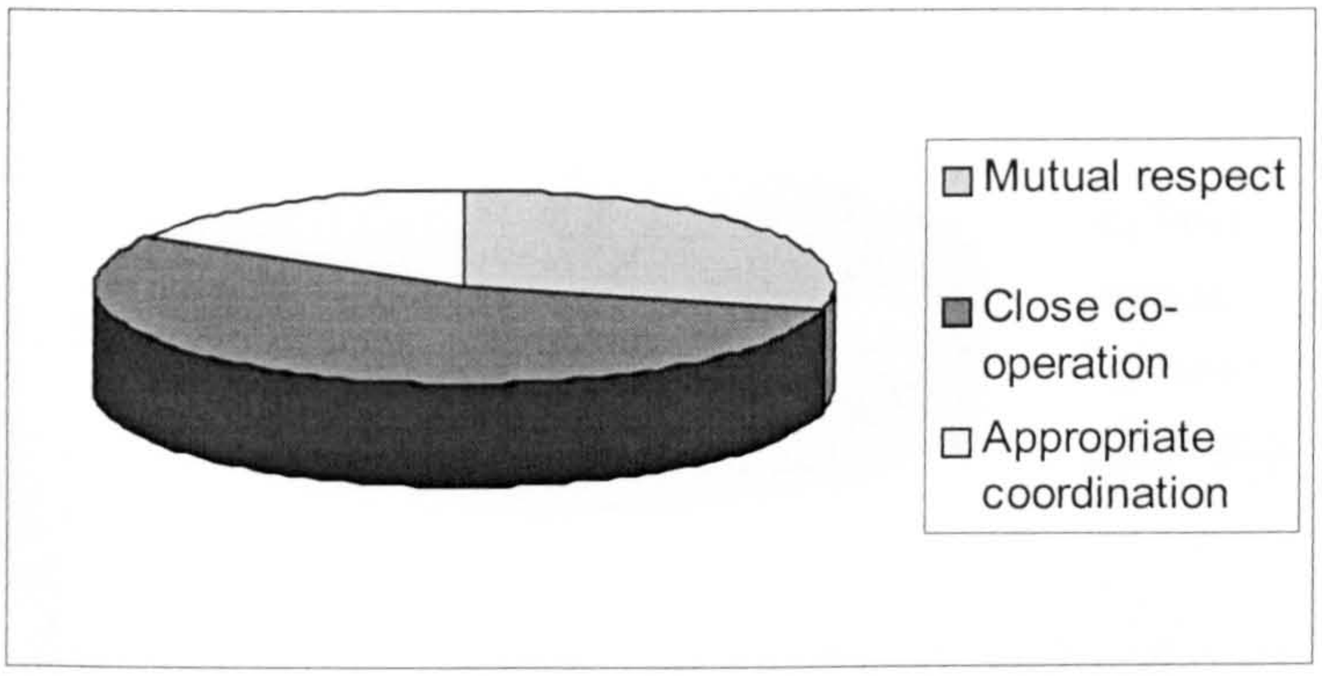


Chart 15. Factors of successful knowledge transfer

Motivators of successful knowledge transfer

In terms of the motivators in achieving a successful knowledge, in the study, 37.94% of the respondents have chosen "mutual benefit", 34.43% of the respondents have chosen "collaborative attitude" while 27.63% of the respondents have chosen "completion of task" in the Main Study. Chart 16 shows the motivators of successful knowledge transfer.

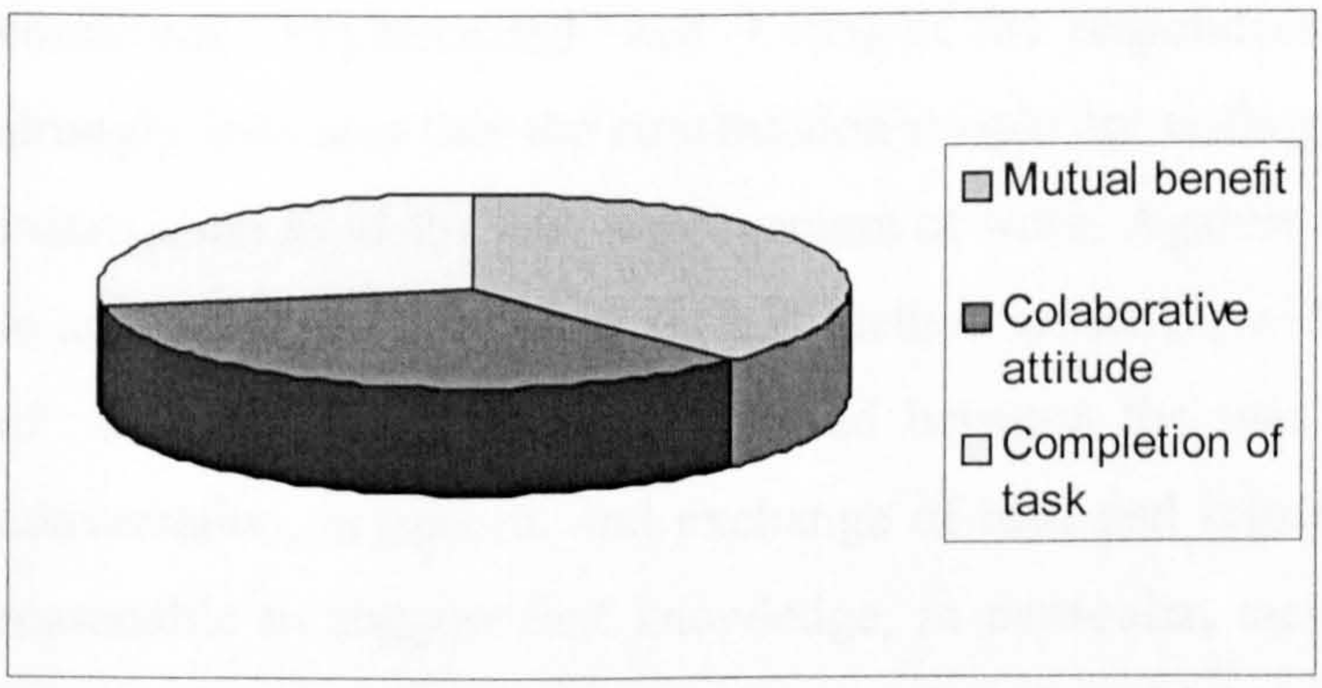


Chart 16. Motivators of successful knowledge transfer

11. Key and Critical Issues

In construction, time, cost, safety and quality are always important issues. However, the data from the Main Study show that people pay more attention to quality and safety issues rather than time and cost issues. "Safety" accounts for 31.43% and "quality" accounts for 40.63% while "Time" accounts for 9.21% and "cost" accounts for 21.90%.

Chart 17 shows the different implications of the attitude of the respondents towards this issue.

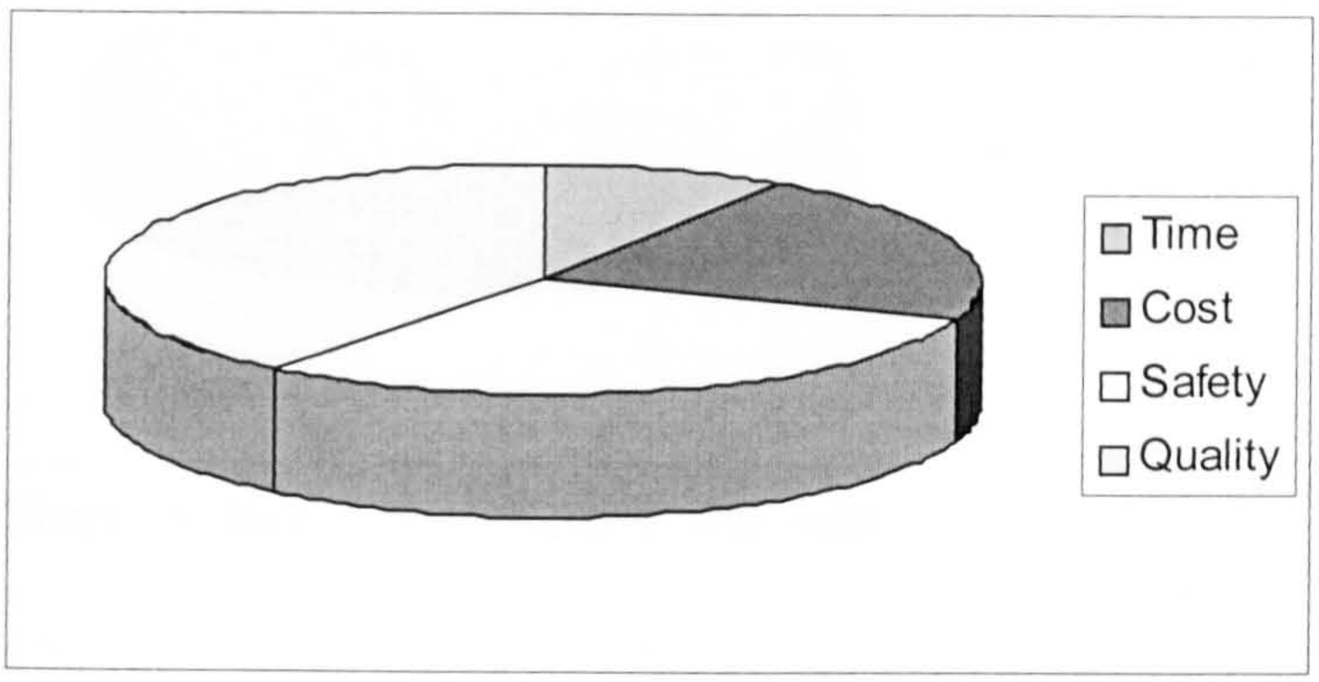


Chart 17. Key and critical issues

12. Consequence of Knowledge Transfer

During the whole life of a project contract, there are problems, some of them are technical, some of them are personnel, some of them are easy to solve, some of them are not. However, the discussion of a method statement is one of the ways to resolve various problems in order to make a successful project. In the study, 74.29% of responses confirmed that the method statement was "revised" after the discussion of the method statement between foreign and local partners while 16.26 of the respondents confirmed "implemented" and 9.45% of the respondents confirmed "rejected". This strongly indicates that the construction people are willing to exchange ideas and share information so as to make improvement of work. Against this background, it is possible to argue that this revised or refined method statement will contain significant elements of knowledge that has been flowed between the two parties when they have the conversation, argument, and exchange of idea and information. From this study it is reasonable to suggest that knowledge, in particular, tacit knowledge was transferred during the discussion of the method statement, which is in this study referred to that "tacit knowledge transfer was achieved through intimate human interaction". Chart 18 shows that the result of the discussion of the method statement leads revision of it.

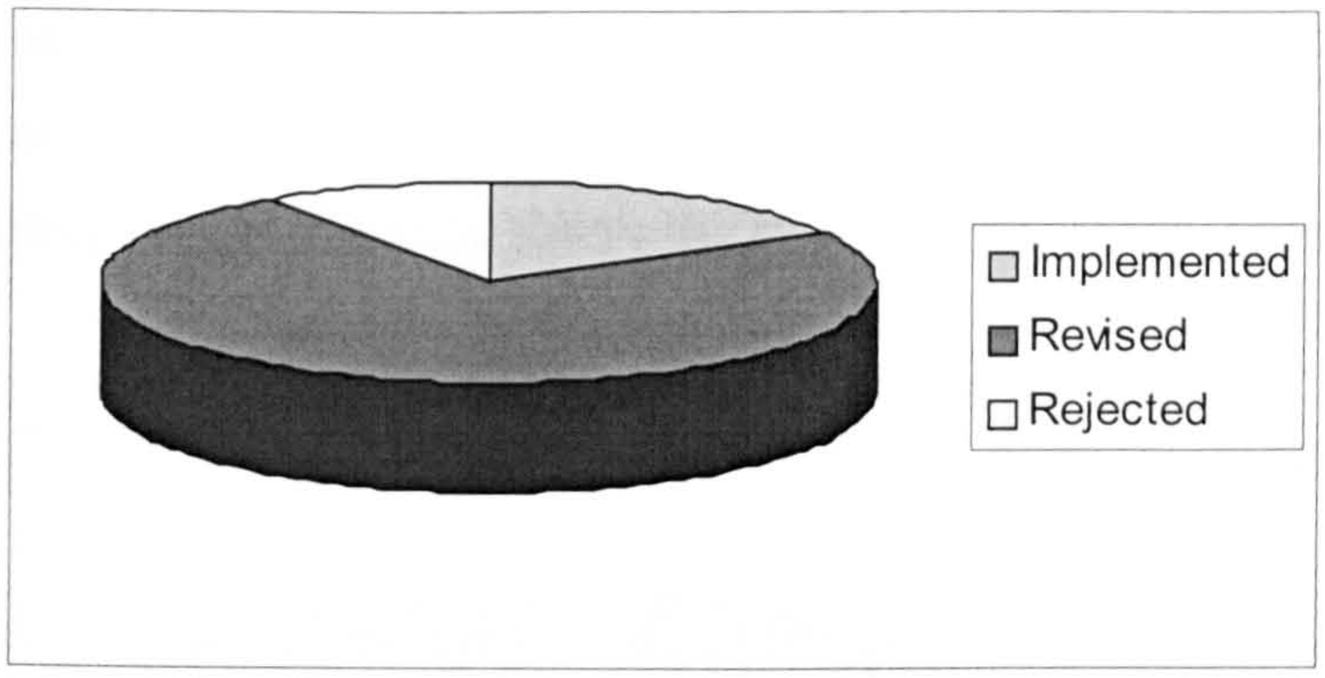


Chart 18. Revision of method statement

If this method statement was revised or rejected, 59.47% of the responses in the study confirmed that the actual method statement was devised through comprise by both parties, while 12.92% of the respondents confirmed "by the local", 16.48% of the respondents confirmed "by the foreigner" and 10.47% of the respondents confirmed "by the third party". That seems the reconfirmation of the previous findings that mutual benefit, close co-operation and appropriate coordination are the important factors in achieving a successful knowledge transfer. Chart 19 shows the attitude of compromise in dealing with method statement.

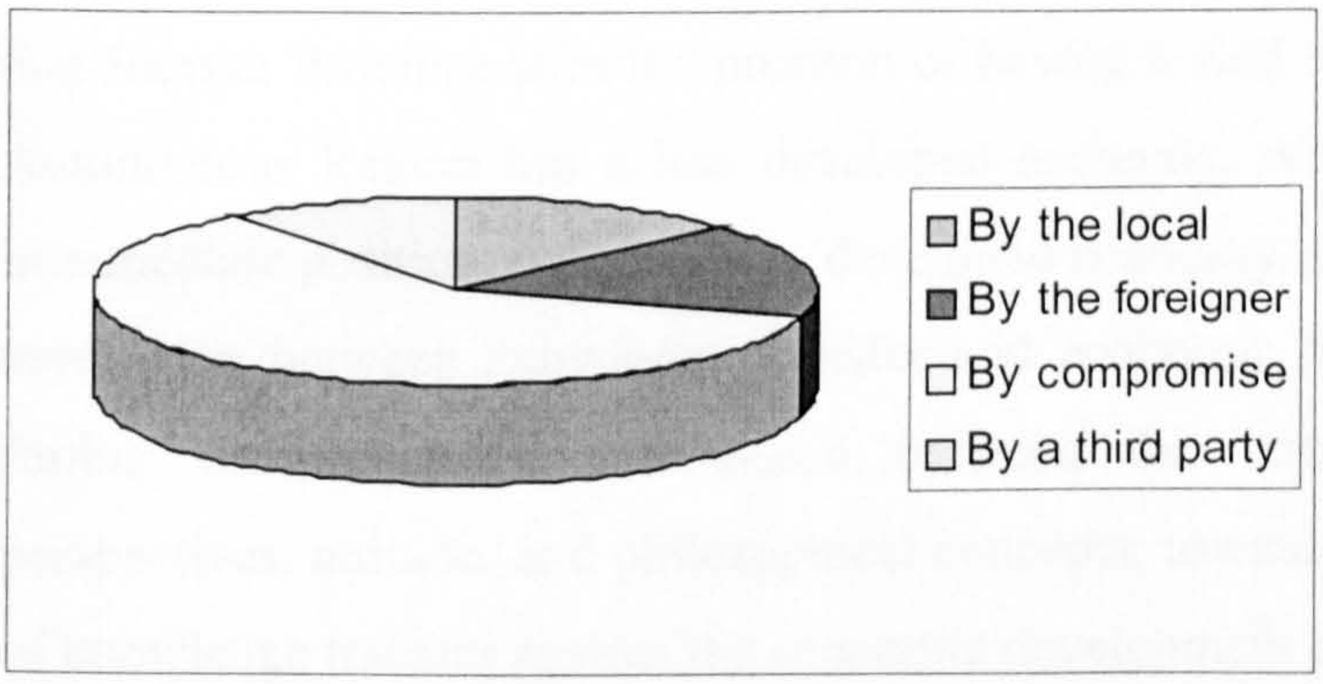


Chart 19. Compromise in dealing with method statement

There is no doubt that knowledge transfer is a positive thing and is important because of the close relationship between knowledge transfer and economic development. A predominantly majority of 71.65% of the responses in the study has confirmed the proposition. Chart 20 shows the result of knowledge transfer.

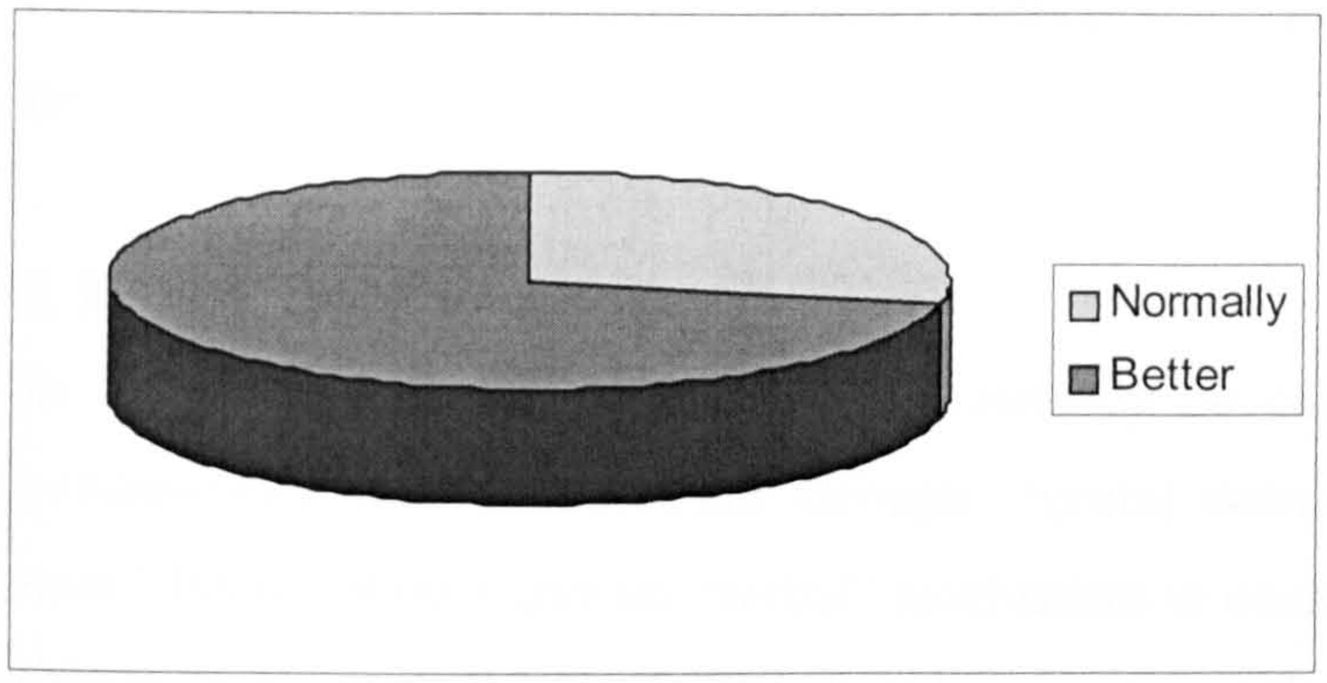


Chart 20. Consequence of knowledge transfer.

8.4.3. Explaining the Relationships between Knowledge Transfer and Economic Development

In the last chapter, based on the comprehensive analysis of the economic condition of Jiangsu Province, Henan Province and Xinjiang Autonomous Region, it was concluded that Jiangsu Province is in the position of having a well developed economy, Xinjiang Autonomous Region has a less developed economy, while Henan Province is in an intermediate position, with a newly developed economy. However, bearing in mind the correlation between knowledge transfer and economic development, the data allows further comprehensive comparison between the three economies in terms of perspectives, attitude, and philosophical concepts, towards the phenomenon and issues of knowledge transfer against the economic development levels.

In this section, it is intended to present and compare the different philosophy, attitude and perspective of people towards knowledge transfer issues in the different regions so as to identify various associations between knowledge transfer and economic development and the coherent relationship between explicit knowledge transfer and

tacit knowledge transfer. **Appendix 6** shows a comparison of data collected from Jiangsu Province, Henan Province and Xinjiang Autonomous Region, PRC.

1. Reasons of for Using a Method Statement

In the last section, the various reasons for using a method statement was explained in detail. Therefore, "reasons for using a method statement" will not be dwelt upon in order to avoid the overlapping.

2. Form of the Method Statement

In Jiangsu and Henan, there is a clear tendency for construction people to prefer to communicate method statement through "formal document" rather than "sketch or note". People almost give up "verbal" mechanism to communicate method statement. It should be pointed that "verbal" communication of method statement had been almost avoided in Henan. However, in Xinjing Autonomous Region, "formal document", "sketch or note" and "verbal" account for 41.58%, 32.67% and 25.74% respectively. Therefore, compared with Jiangsu and Henan, it seems that there is a lesser tendency for managers in Xinjiang to use "formal document" rather than "sketch or note" and "verbal". It is clear that the different attitude of using method statement among the 3 regions implies that in a well developed economy people tend to communicate important issues through a structured way, while in a less developed economy people have not established the idea, which the important issues should be dealt with appropriate mechanism. Chart 2 represents these different implications.

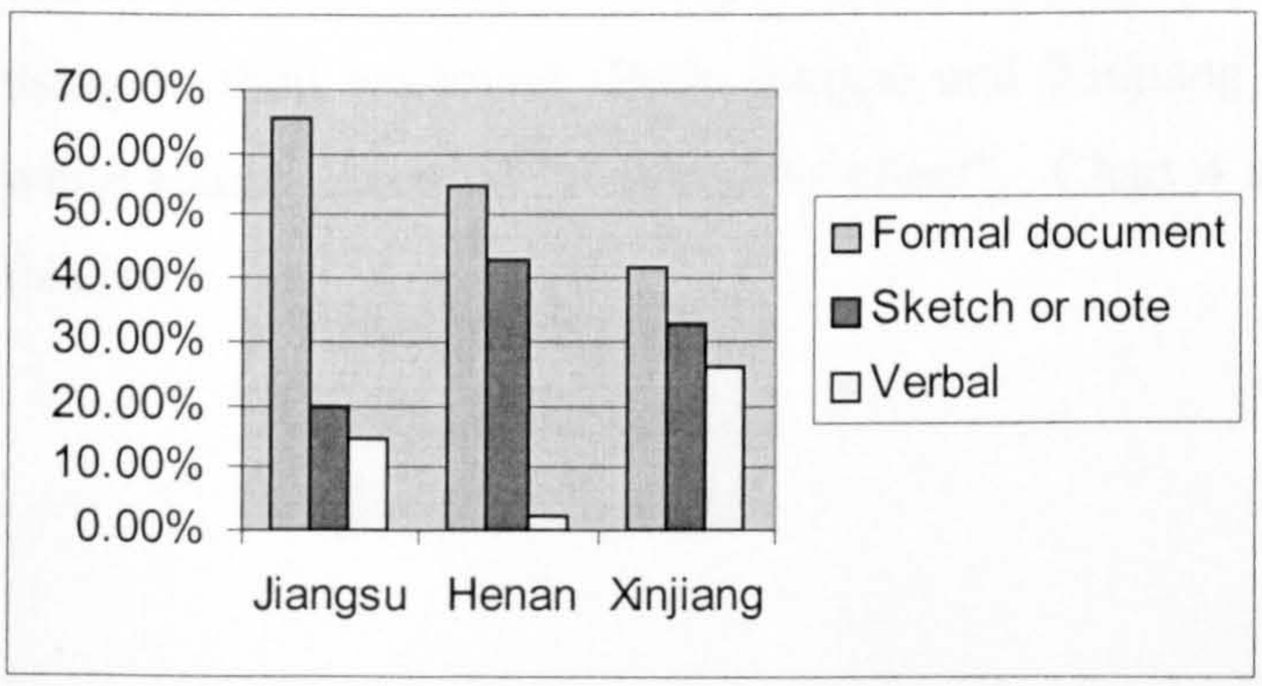


Chart 2. Comparison of form of method statement

3. Foundation of the Method Statement

In terms of the foundation of method statements, a majority (53.37%) of responses indicated that the form of method statement was mainly based upon "contract document", which has confirmed that method statement is a part of the contact and a pre-requisite of doing construction project. It should be noted that there is a high percentage of respondents in Xinjiang to indicate that the form of method statement is based on "handmade on spot", Henan is in the intermediate position, while Jiangsu does not favour having method statement through "handmade on the spot". The different attitude towards this point suggests a strong correlation between knowledge transfer and economic development. Chart 3 represents the comparison of foundation of method statement.

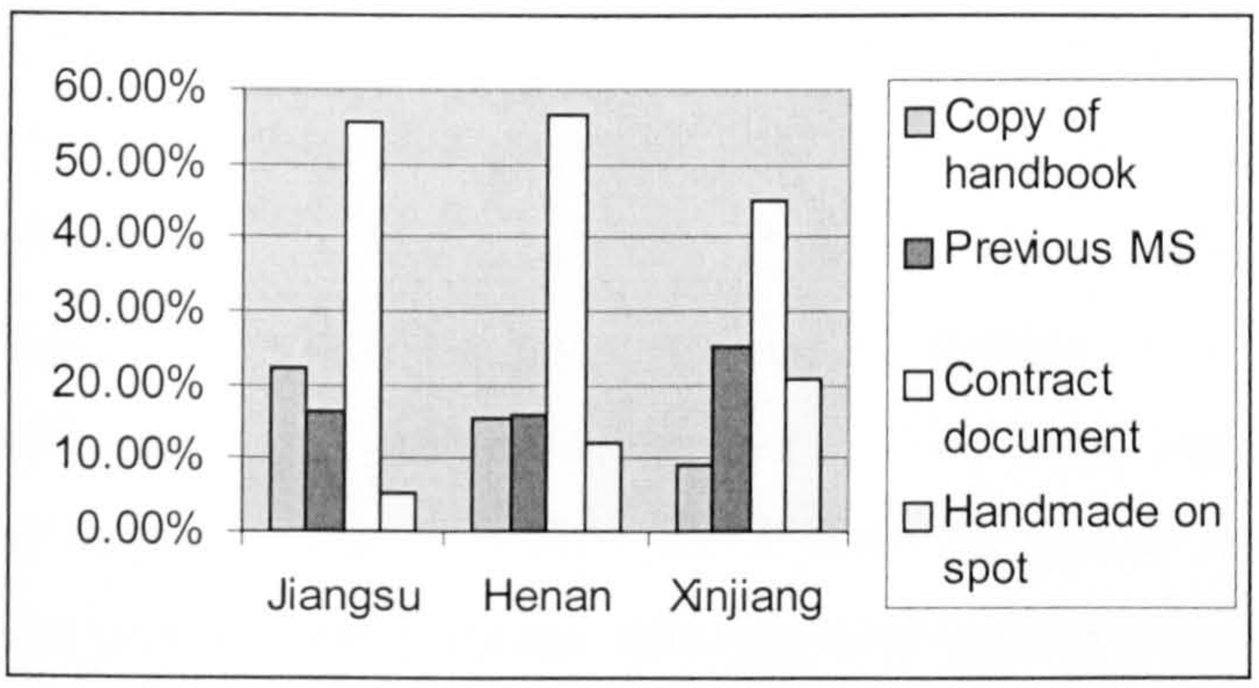


Chart 3 Comparison of foundation of method statement

4. Further Reasons for Using a Method Statement

The respondents in the three regions held different views towards the further reasons of using method statement. Both Jiangsu and Xinjiang favoured "resource allocation" while Henan favoured "required by client". Chart 4 shows the different views about this issue.

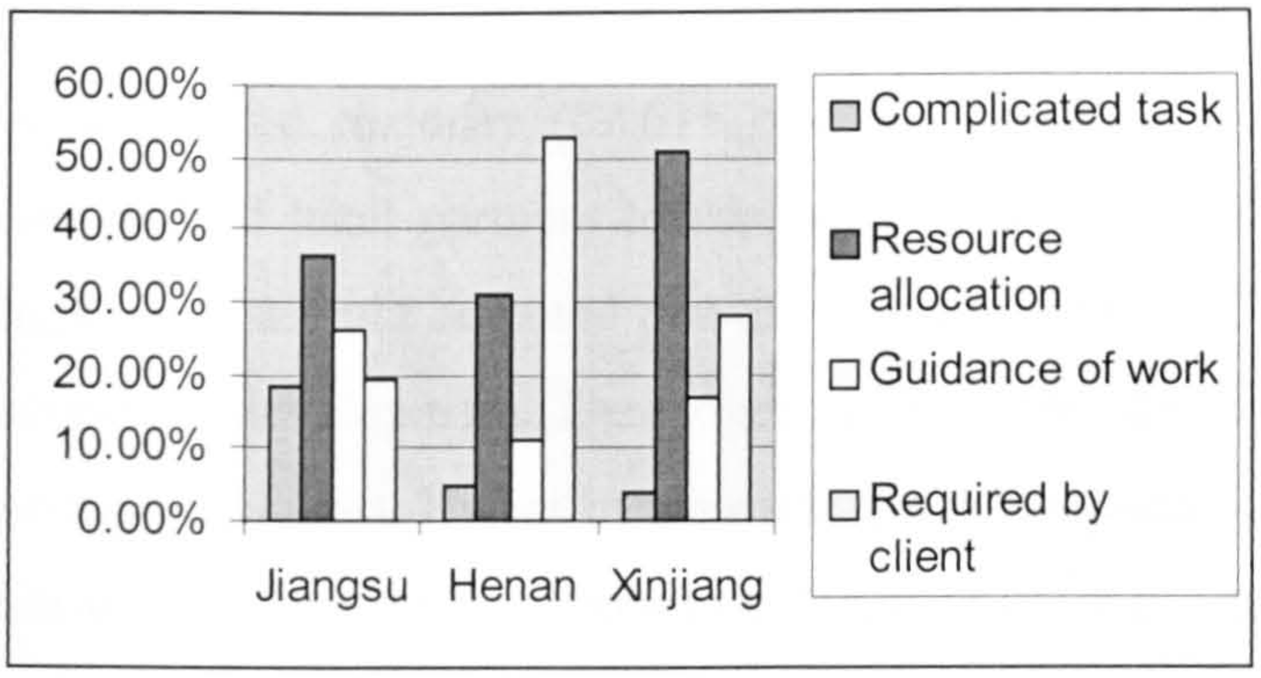


Chart 4. Comparison of further reasons of method statement

5. Authority over a Method Statement

In terms of which party has the authority over the method statement, a general tendency confirmed by dominant majority of 59.21% of the responses is that the foreign and local partners should work together closely and make decision together, while in the study 18.34% of the responses still favour the local party and 22.34% of the responses still favour the foreign partner. However, Henan province prevails over the other two regions in supporting the view that "the foreign and local parties should work together and solve the problems together". This data implies that in the less developed economy, people are still confused about the mechanism of knowledge transfer. Chart 5 shows which party has the authority over method statement.

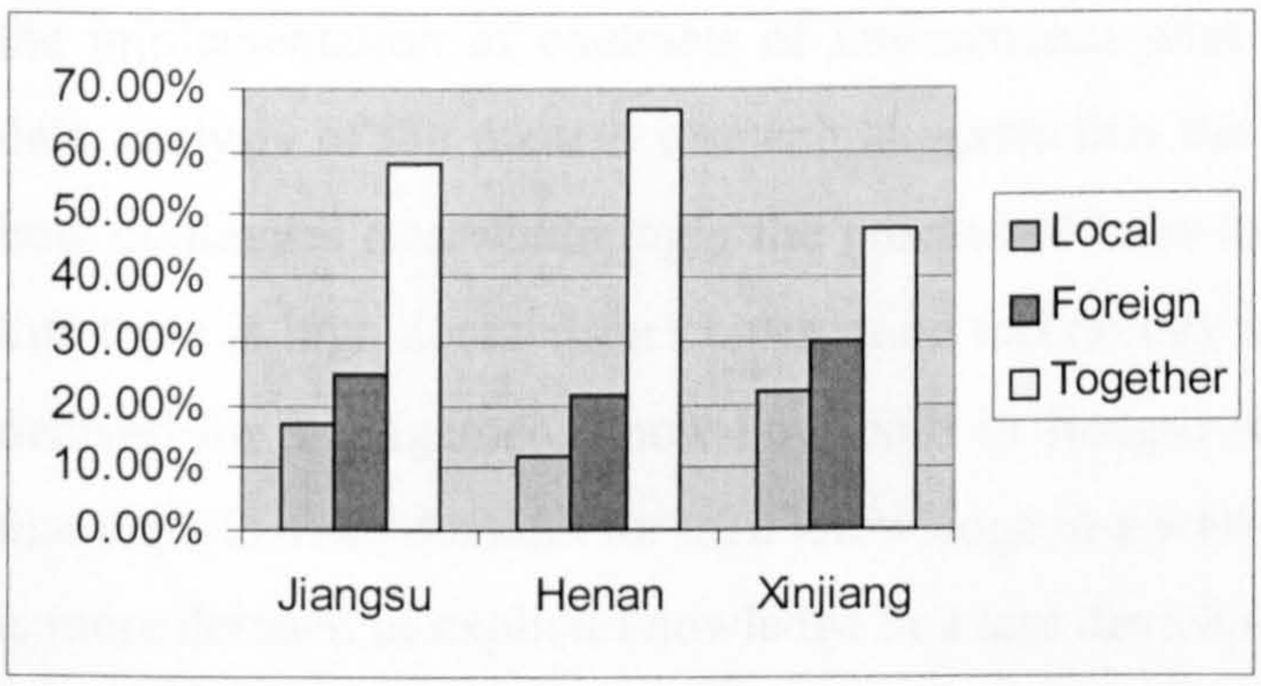


Chart 5 Comparison of authority over method statement

6. Parties Involved with Method Statement

A dominated majority (67.61%) of the responses confirmed the need for both the foreign and local partners to discuss method statements together and solve problems together. It should be noted that the attitude towards this issue is positively related with economic development. The "together" columns have formed into a ladder with Jiangsu being the highest, Henan in the middle and Xinjiang the lowest. This data suggest that knowledge transfer and economic development has a strong relationship and positively effected. (refer Chart 6).

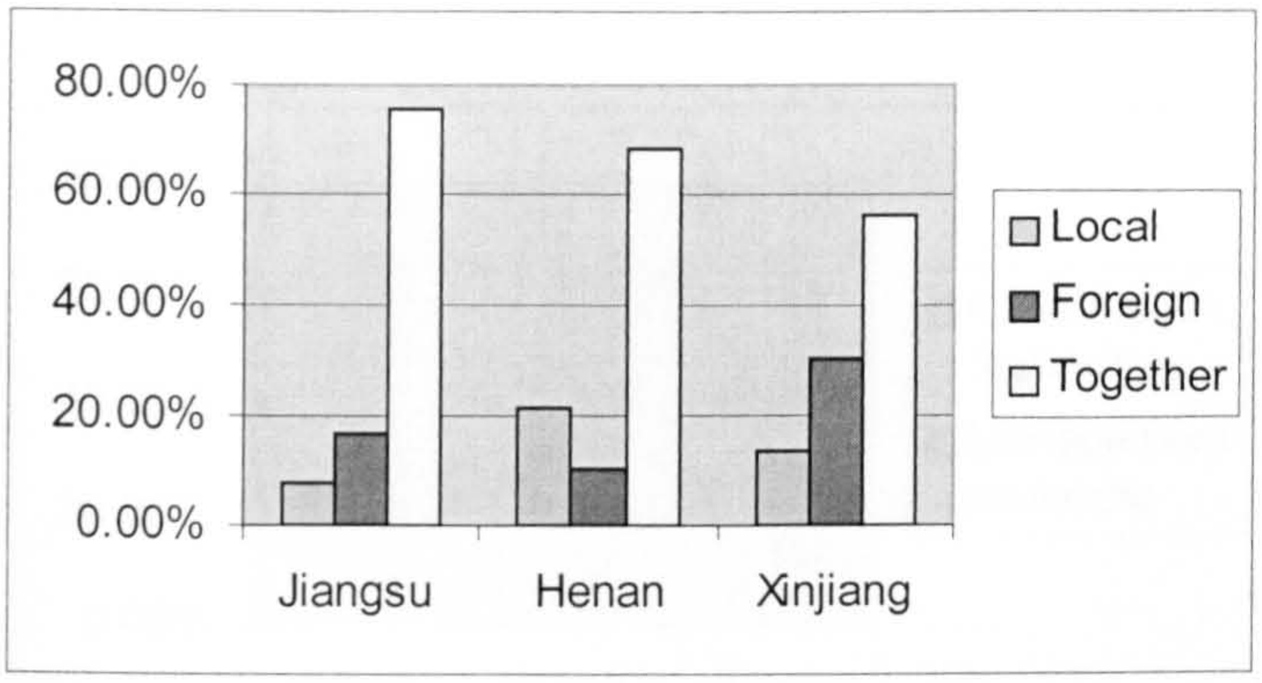


Chart 6. Parties mainly involved

7. What Is Being Transferred

Based upon the study, it is reasonable to assume that knowledge transfer occurs during the implementation of contracts of international joint venture projects. However, the data analysis of the present research suggests that the transfer of management know-how dominates overwhelmingly the process of knowledge transfer. It should be noted that there is high demand for construction technology in Xinjiang while there is a high demand for management know-how both in Jiangsu and in Henan. This data suggest that there is more demand for tacit knowledge in a well developed economy while there is more demand of explicit knowledge in a less developed economy. Chart 7 represents what needed to transfer whereas Chart 8 represents what actually did transfer in practice.

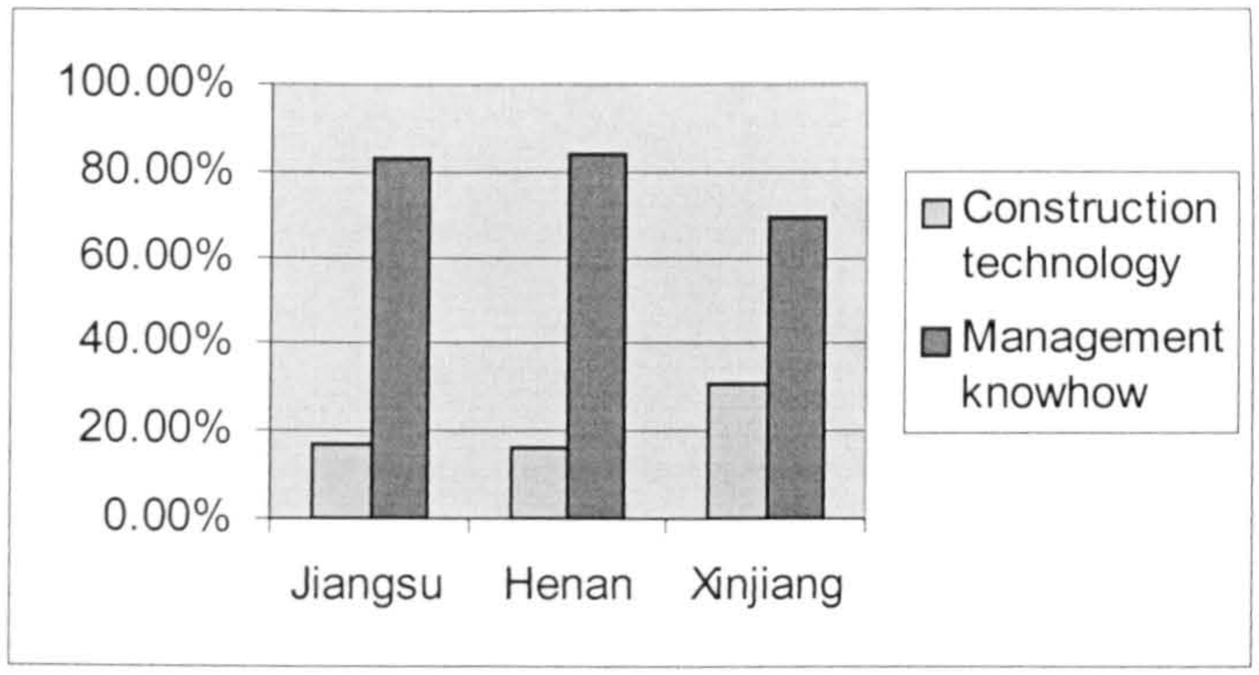


Chart 7. Comparison of what needed to transfer

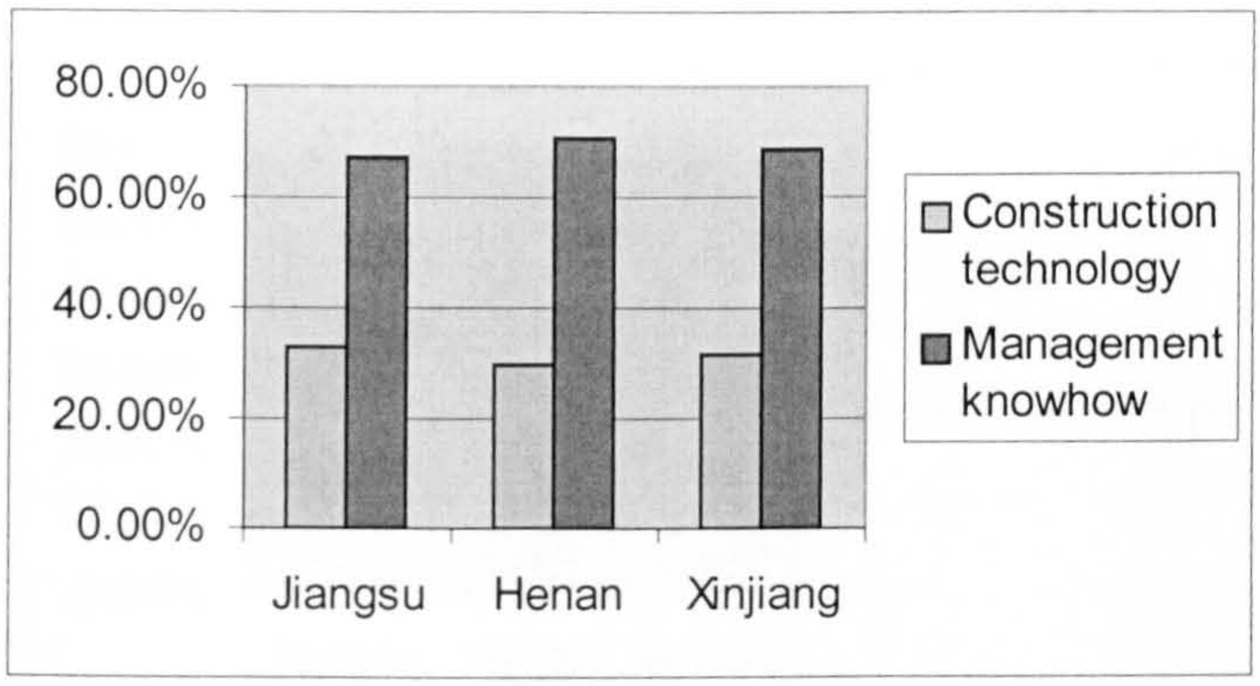


Chart 8. Comparison of what did actually transfer

8. Explicit Knowledge or Tacit Knowledge

The comparison of the data suggests that the transfer of tacit knowledge dominates the process of knowledge transfer. However, there is the hesitation of people to express their intention towards explicit and tacit knowledge transfer. In particular, this is the case in Xinjiang, where people are not clear about the concept of explicit and tacit knowledge. However, there is a clear tendency in Jiangsu that people have significant demand for transfer of tacit knowledge while Henan still remains in the intermediate position. Chart 9 shows what needed to transfer while Chart 10 shows what did actually transfer in practice in terms of explicit and tacit knowledge.

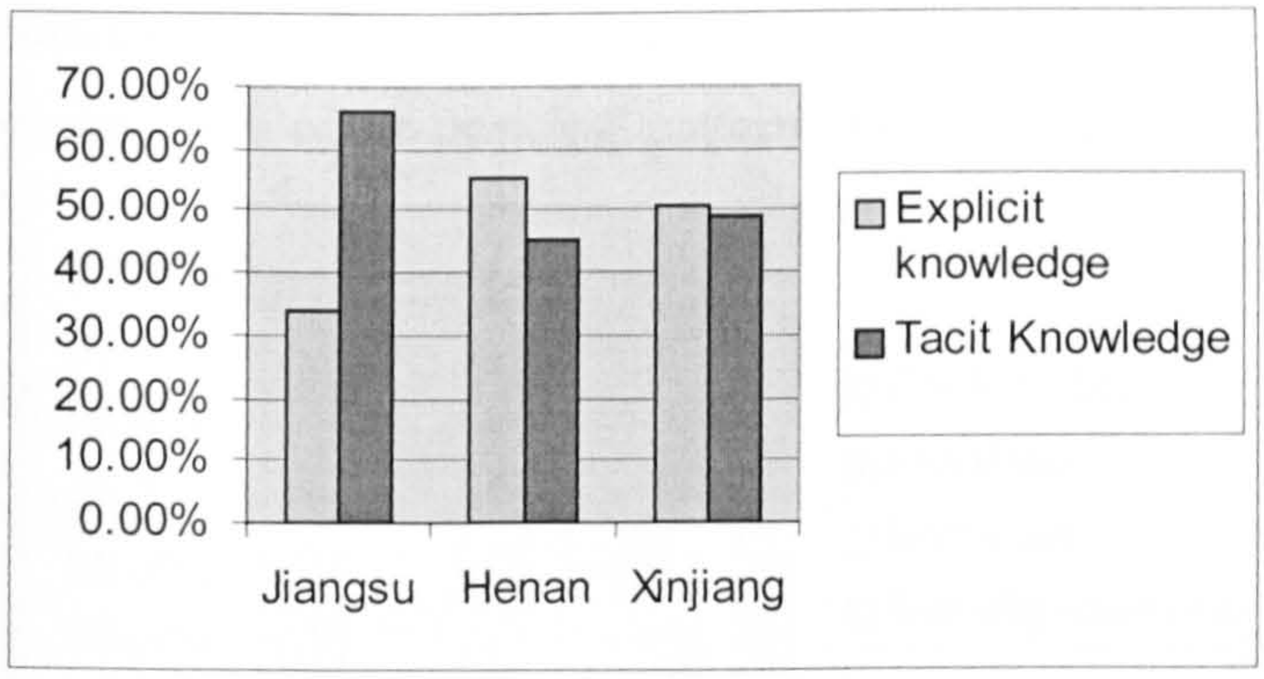


Chart 9 Comparison of what needed to transfer

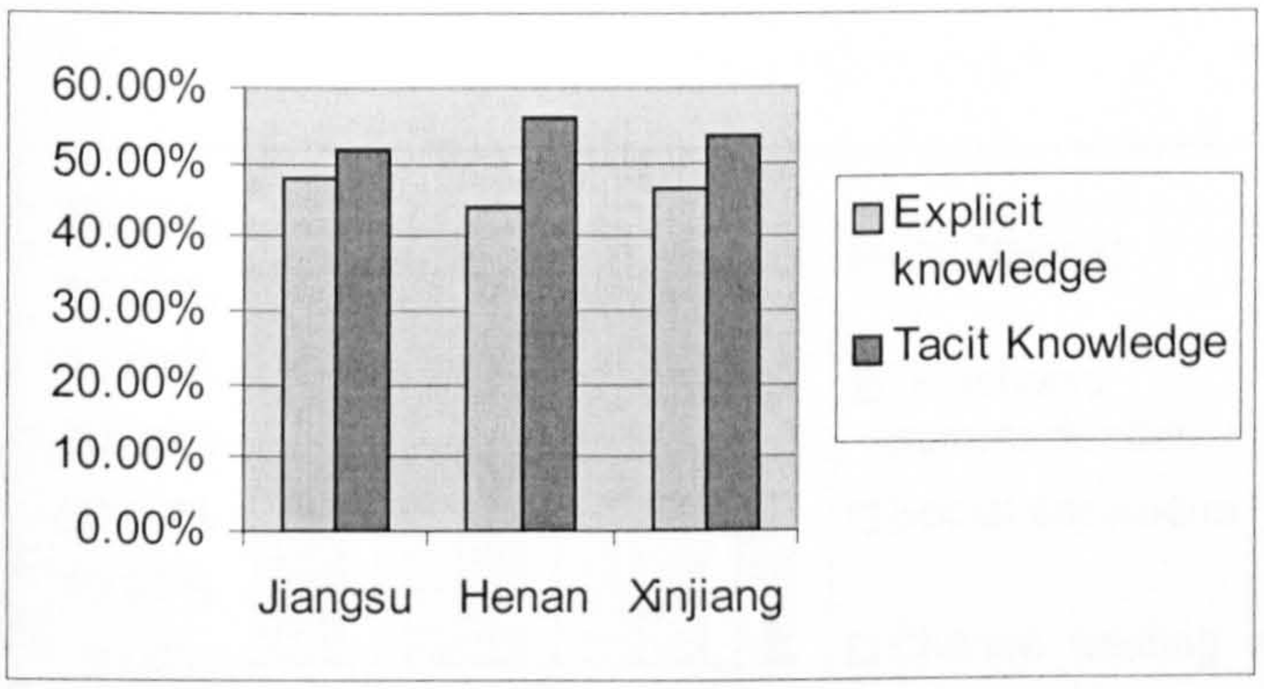


Chart 10. Comparison of what did actually transfer

9. How Was Knowledge Transferred

It has been identified that both explicit knowledge and tacit knowledge have special ways of transfer. There is no agreement regarding the main channel of transfer among the regions. However, the data show that construction people in Henan believe "meeting" is the main channel of explicit knowledge transfer while in Xinjiang believe "seminar" is the main channel of explicit knowledge transfer. In Henan it is believed that "job training" is the main channel of tacit knowledge transfer while Jiangsu and Xinjiang believe "social occasion" is the main channel of tacit knowledge transfer.

The analysis suggests that knowledge transfer is a "two-way process". However, construction managers in Henan strongly believe that knowledge transfer take place "from foreign partners to local partners" while in Xinjiang feel that there is transfer from "local to foreign". These data suggest that people in Xinjiang are still unclear about the basic elements and the definitions of knowledge transfer. Chart 11 shows the comparison of the main channel of explicit knowledge transfer, Chart 12 shows the

comparison of the main channel of tacit knowledge transfer, while Chart 13 shows the comparison of the principal pattern of knowledge transfer.

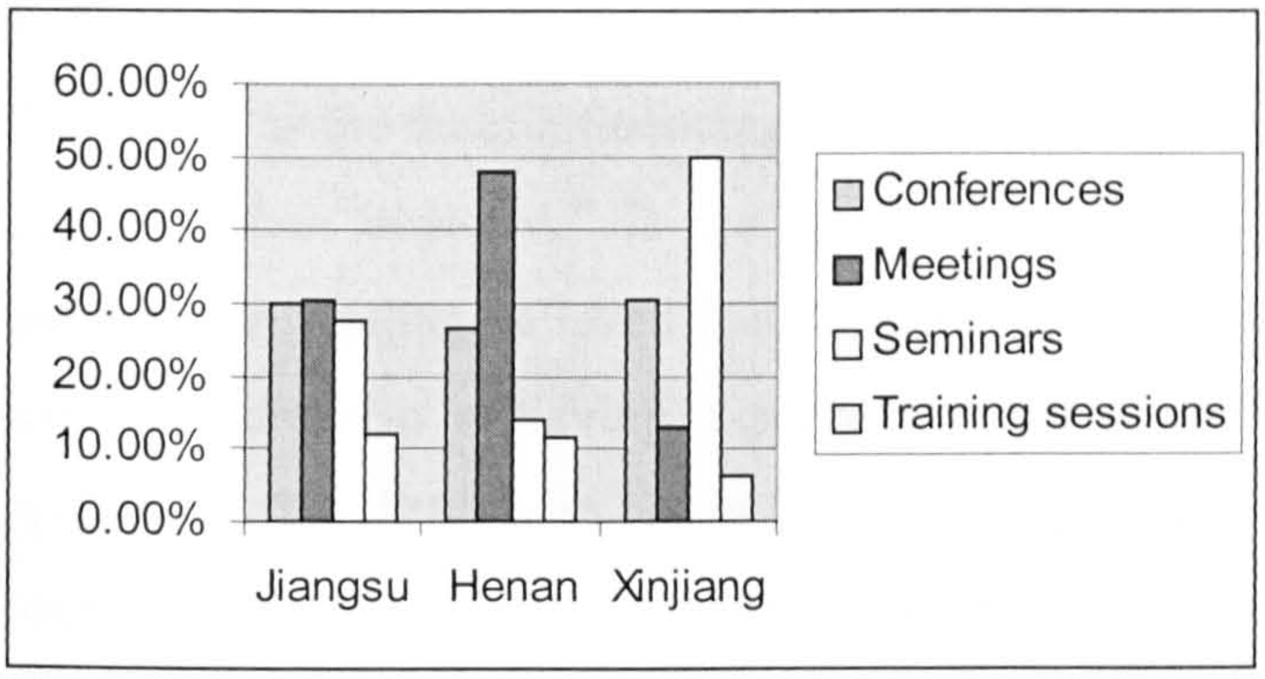


Chart 11. Comparison of main channels of explicit knowledge transfer

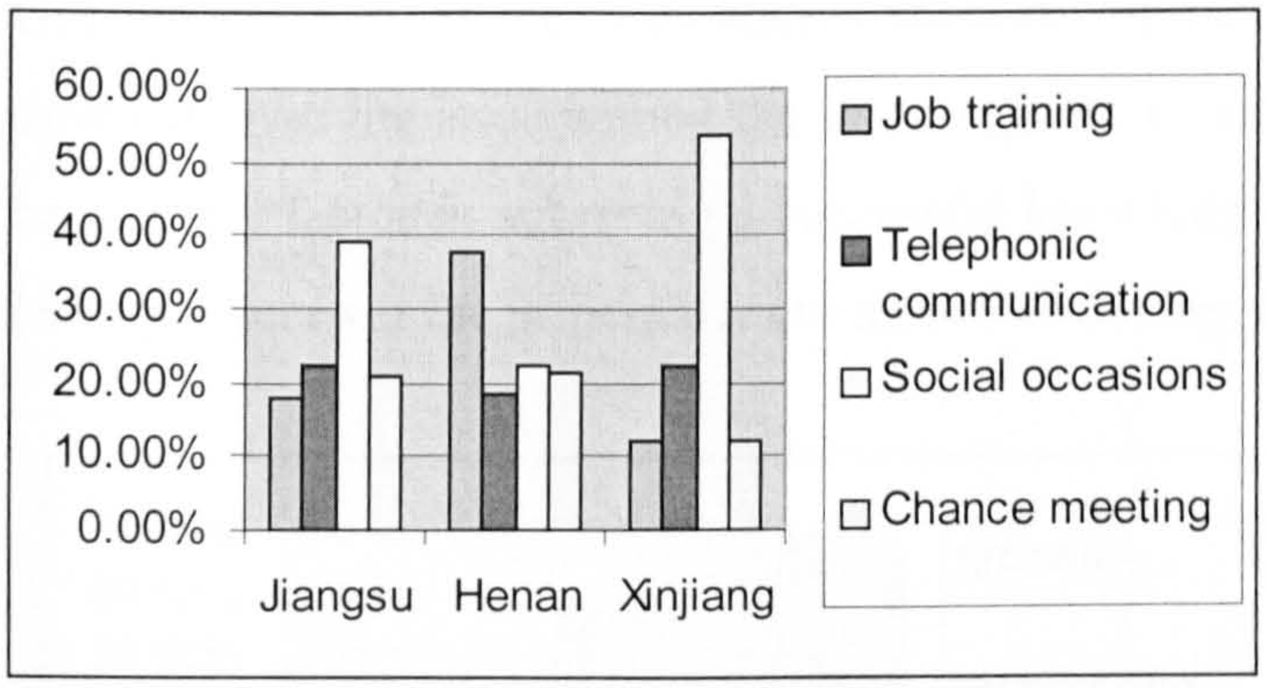


Chart 12. Comparison of main channel of tacit knowledge transfer

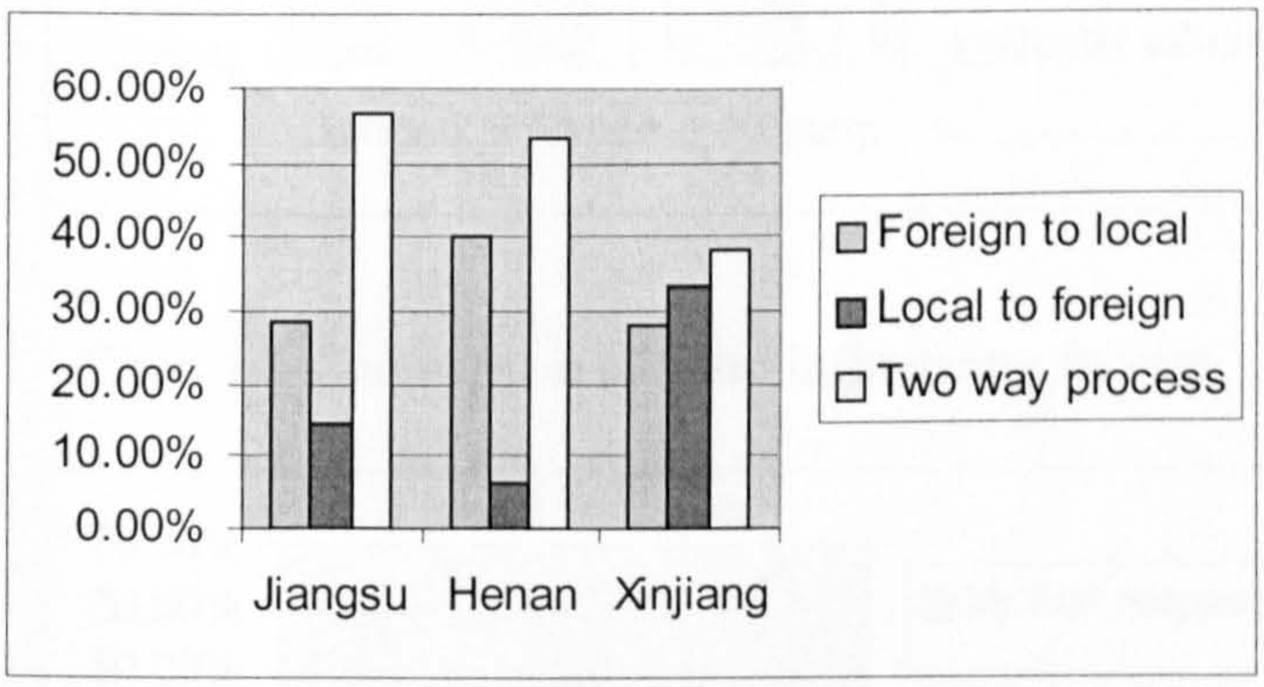


Chart 13. Comparison of the principal patterns of knowledge transfer.

10. Success of Knowledge Transfer

In terms of which factor is the main influencing factor of knowledge transfer, it should be pointed out that a clear majority (75.83%) of responses in Henan believe that "language" is the main influencing factor and 36.42 % of responses in Jiangsu believed that "common objective" is the main influencing factor, whereas 32.32% of the responses in Xinjing believed that "culture" is the main influencing factor. In terms of principal factor in achieving a successful knowledge transfer, however, there is an agreement that "close co-operation" is the primary factor in achieving successful knowledge transfer. In terms of principal motivator in achieving successful knowledge transfer, it is notable that in Jiangsu 44.74% of the respondents favours "mutual benefit", while in Henan 51.26% of the respondents favours "completion task", and in Xinjiang 40.00% of the respondents favours "mutual benefit". Chart 14 shows the argument over the issue among the three regions. Chart 15 shows the comparison over the primary factor in achieving a successful knowledge transfer while Chart 16 shows the argument over the principal motivator in achieving successful knowledge transfer.

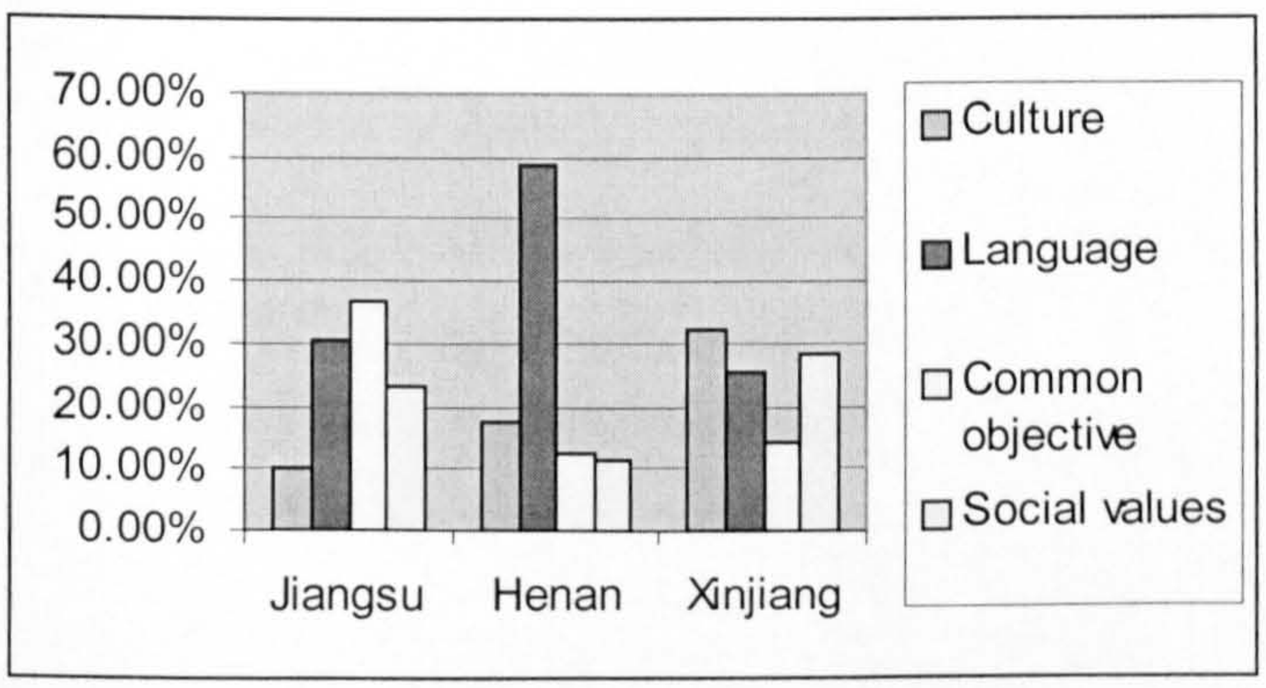


Chart 14. Comparison of main influencing factors

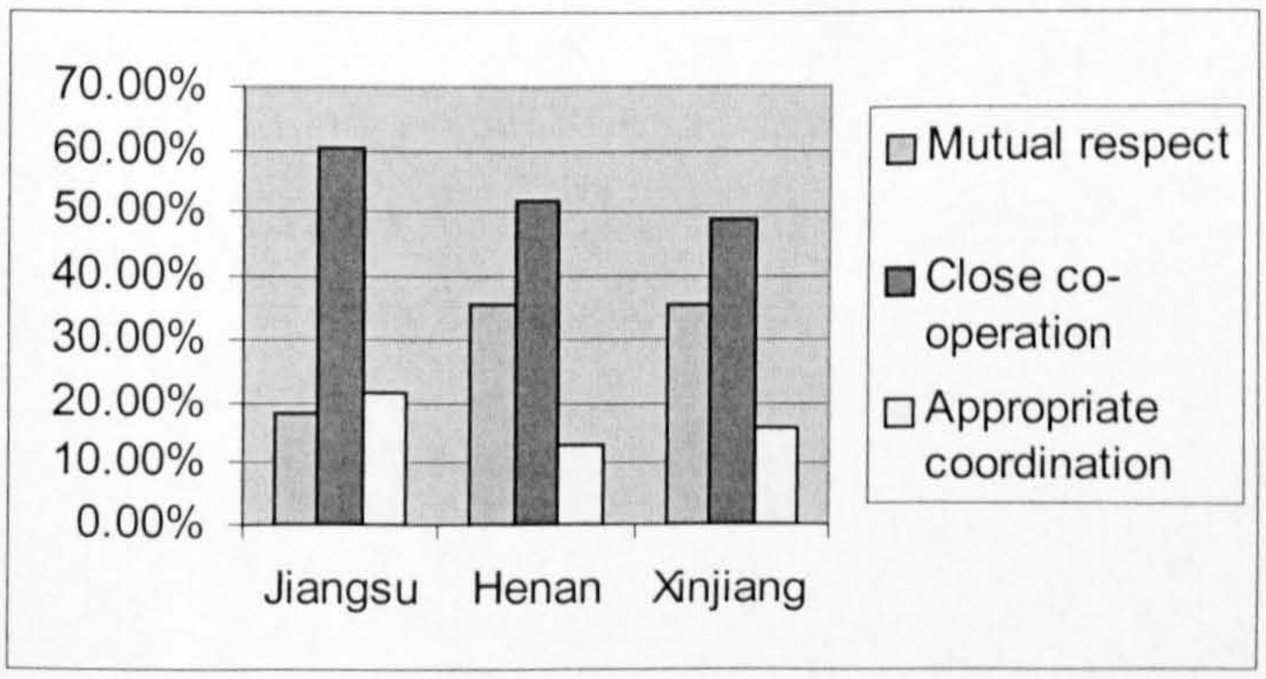


Chart 15. Comparison of principal factor in achieving successful knowledge transfer

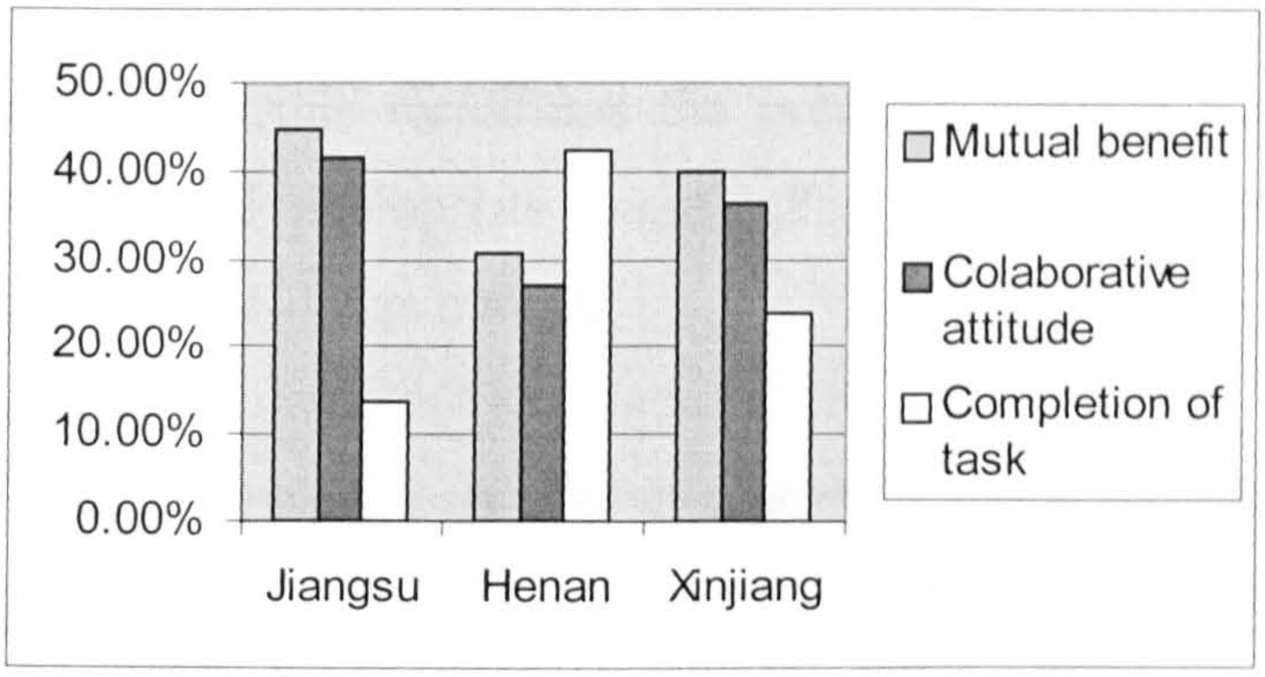


Chart 16. Comparison of principal motivator in achieving successful knowledge transfer

11. Key and Critical Issues

It seems that there is agreement that the construction maangers in Xinjiang, Henan and Jiangsu pay attention to quality, safety, cost and time. However the degree of attention to the above four issues decreases from "quality" issue to "time" issue gradually. Chat17 shows the comparison of these particular issues.

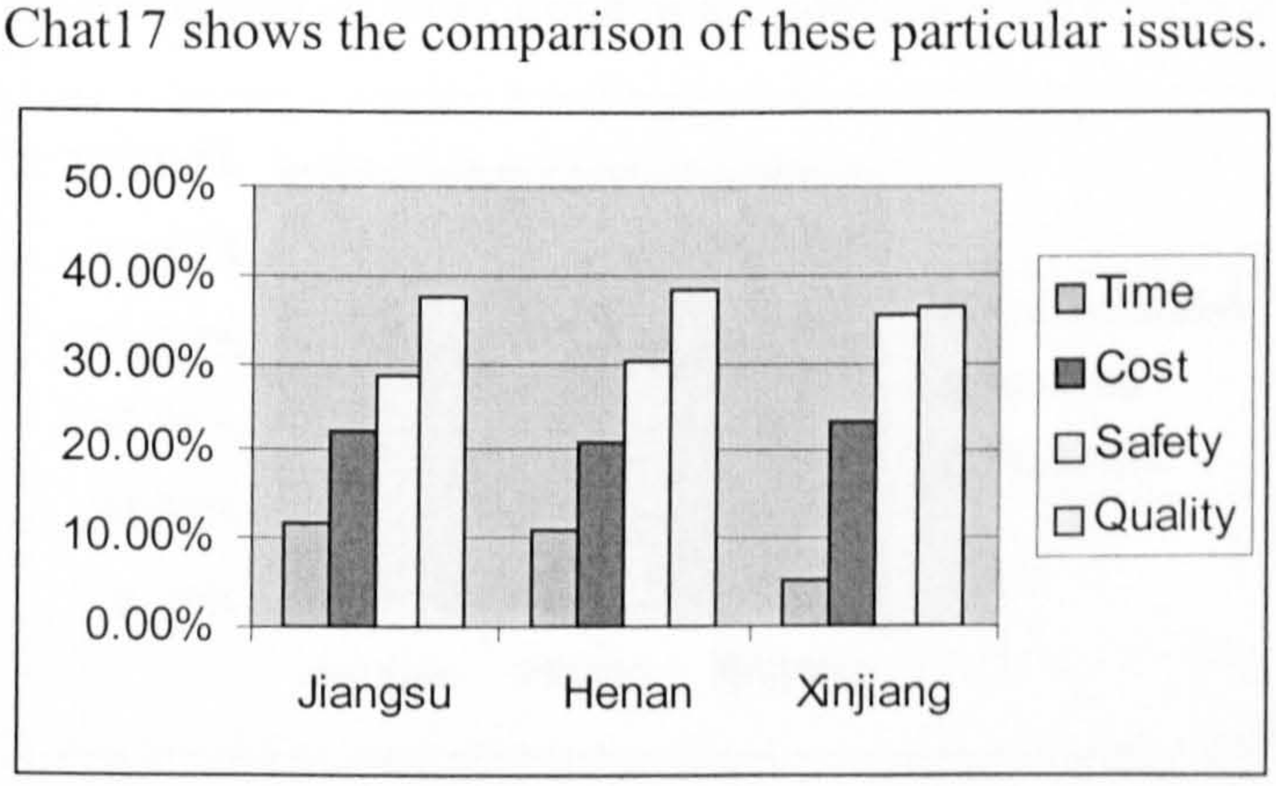


Chart 17 Comparison of the key and critical issues

12. Aftermath of Knowledge Transfer

An interesting finding of this study is that the majority of respondents, (83.64% Jiangsu, 61.24% in Henan, and 69.00 % in Xinjiang), confirmed that the method statement will be revised as a result of discussion of the method statement.

"*If this method statement was revised or rejected*", the majority (61.59% in Jiangsu, 55.00% in Henan and 48.42% in Xinjiang) confirmed that the actual method statement was devised through compromise between the foreign and local partners.

It seems that this reconfirms the previous findings that mutual benefit, close co-operation and appropriate coordination are the important factors in achieving a successful knowledge transfer.

No doubt knowledge transfer is a positive thing and bears significant consequences because of the close relationship between technology transfer and economic growth. The majority (70.12% in Jiangsu, 75.12% in Henan and 71.00% in Xinjiang) has confirmed the proposition. Chart 18 shows the result of discussing a method statement leads to the revision of the method statement. However, this issue is also positively related with economic development, as the "revised" columns have formed a ladder with Jiangsu being the highest, Henan being in the middle and Xinjiang being the lowest. If the method statement was revised or rejected, Chart 19 shows the actual method statement was devised through comprise by both parties. Chart 20 shows the improvement of work done in accordance with the revised method statement.

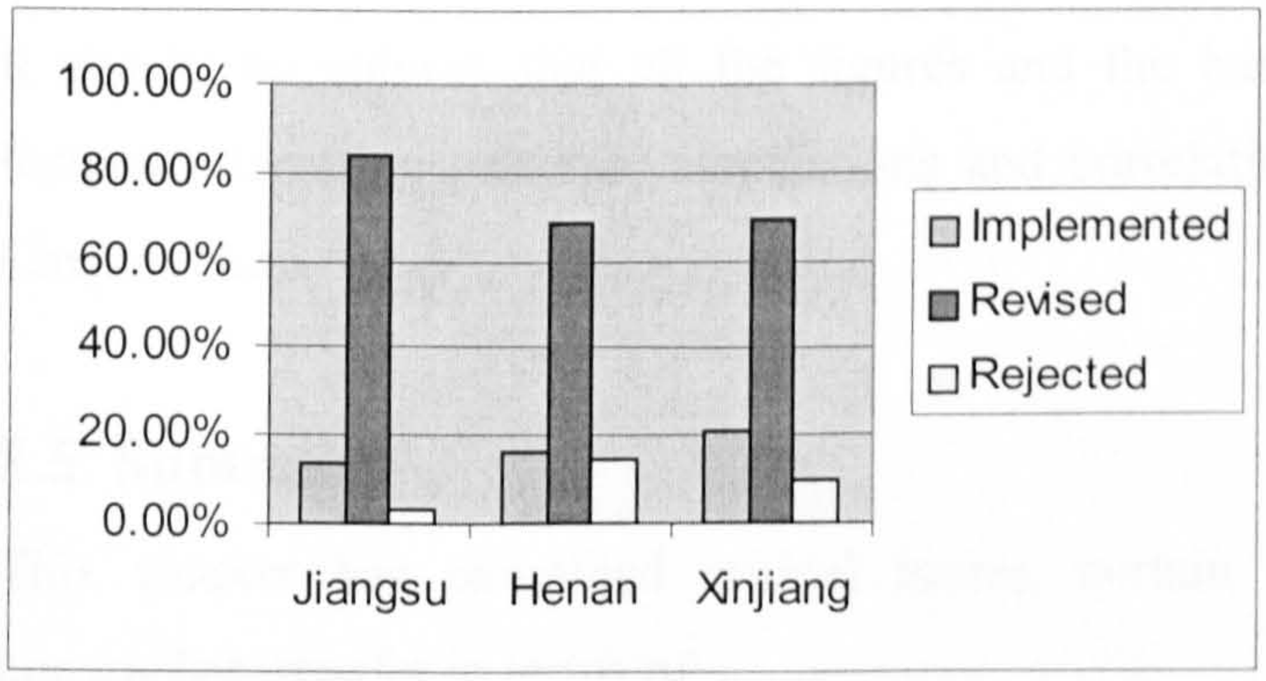


Chart 18. Result of discussing method statement leads to revision of it

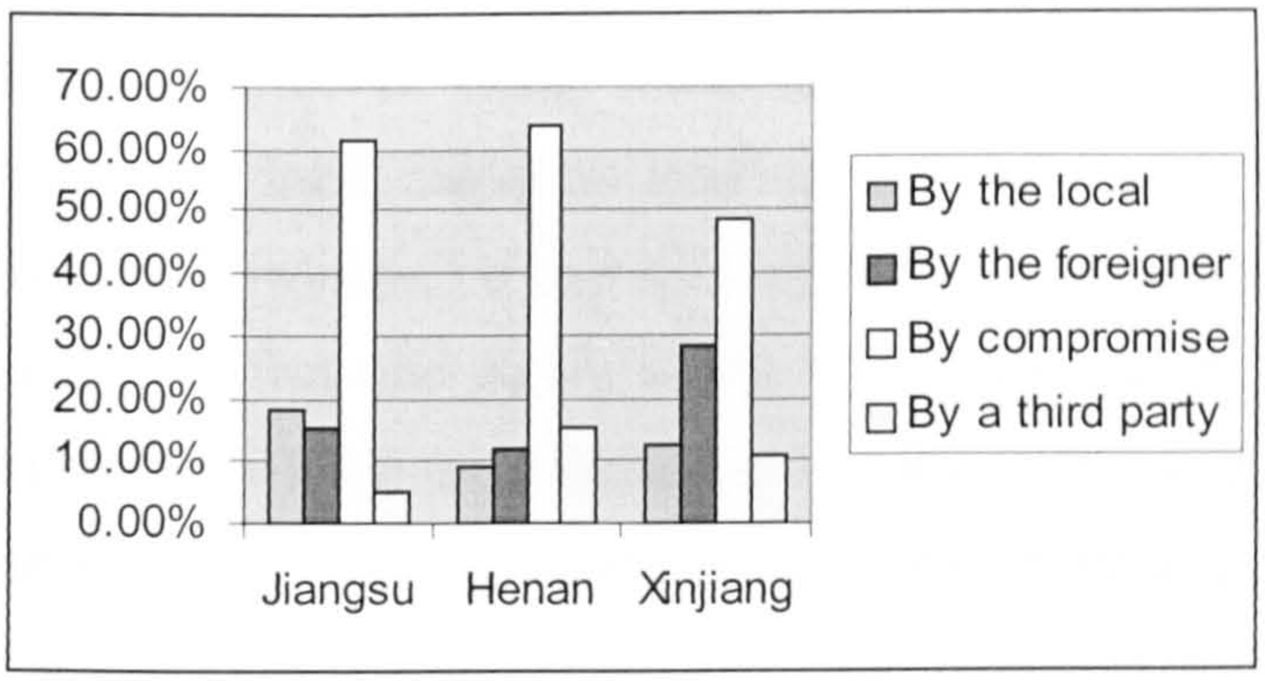
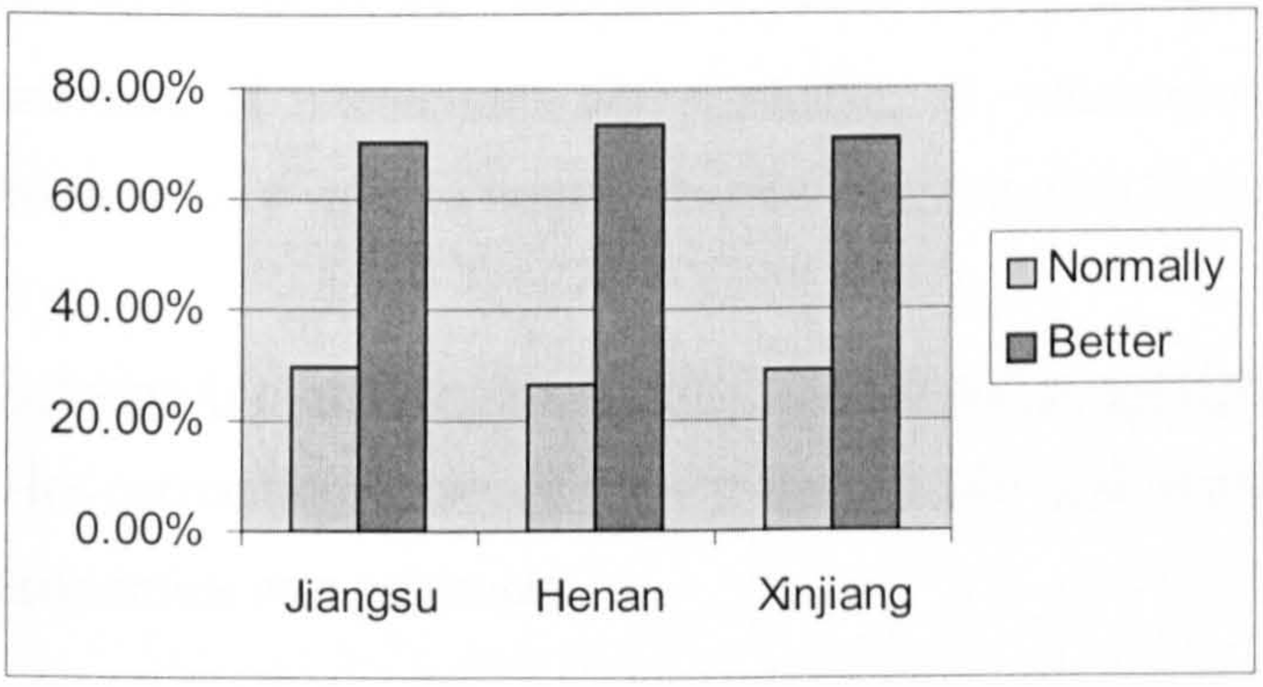


Chart 19. The actual method statement was devised through comprise

Chart 20. Improvement of work done in accordance with the revised method statement.



It should be pointed that all the figures and the bar charts mentioned-above have formed interesting patterns, associations and correlation, which will be presented in Chapter Nine.

8.5. Summary

This chapter has examined critical issues, certain elements and mechanisms of knowledge transfer in terms of:

What has been transferred?

It has been confirmed in the Main Study that during the knowledge transfer process of both explicit knowledge and tacit knowledge, however, tacit knowledge is a major element along with explicit knowledge that has been transferred between foreign and local partners.

How was knowledge transferred?

The analysis of the Main Study data suggests that knowledge is transferred when foreign and local managers have intimate interaction and work together. However, different knowledge, i.e. explicit knowledge and tacit knowledge have different way of transfer. In fact, the nature of the knowledge has decided the way of its transfer. Explicit knowledge is transferred in a formal or structured way while tacit knowledge is transferred in an informal manner, or somewhat arbitrary manner.

Why was knowledge transferred?

It has been identified that the motivation is an important issue of knowledge transfer. In order to achieve the common goal for the completion of a specific project, both foreign and local managers, who are working in a joint venture, need to involve significant amounts of interactions and exchange of information, and knowledge transfer, not because they want to transfer knowledge, but they have to.

Relationship between knowledge transfer and economic development

The correlation between knowledge transfer and economic development in the three economies was presented.

Chapter Nine

Research Findings and Implications

9.1. Introduction

First of all, this chapter examines the aims and objectives of the current research. Following that, the chapter discusses the implications of a relationship between knowledge transfer and economic development and a relationship between explicit knowledge transfer and tacit knowledge transfer in the context of a systematic approach to tacit knowledge transfer. The effect of Xiaolangdi Project itself on responses from Henan will be explored. The chapter then discusses the implications of policy and practice. Finally the chapter presents an assessment of the contribution to knowledge of the study and suggestions for further research.

9.2. Aims and Objectives Are Examined

The aim of the study (re-stated from Chapter 1) was to investigate the current mechanisms of technology transfer and the aspects of technology transfer between foreign and local managers within international joint ventures in China. However, the aim has therefore achieved step by step based on firstly the establishment of a theoretical framework for analysing technology transfer process of construction industry between developed and developing countries, secondly on a pilot study that was undertaken on the Sino-foreign joint venture demonstration project at Xiaolangdi, thirdly on a structured survey that was carried out in Xinjiang, Henan and Jiangsu, People's Republic of China.

The objectives of the study are therefore re-stated here for convenience of discussion in this chapter. They were:

1. From the literature, to establish a theoretical framework for the tracking of the technology transfer process;
2. To establish the basic patterns of knowledge transfer through a pilot study;
3. To evaluate the appropriateness and effectiveness of the study by using a main study;

4. To identify the implications of the relationship between technology transfer and economic development levels.

The extent to which these objectives have achieved will now be examined, taking the objectives one at a time.

Objective 1: A theoretic framework for tracking of the technology transfer process has been established in the study through an extensive review of literature and the current state of knowledge of technology transfer. What has become apparent is that knowledge transfer is crucial during the process of technology transfer *as knowledge is the key to control over technology as a whole.*

Objective 2: The basic patterns of knowledge transfer have been established through the semi-structured interviews of foreign and local managers at Xiaolangdi during the pilot study. Furthermore, a typical management structure of Sino-foreign joint venture in Xiaolangdi was developed, which has provided a platform for the identification of the physical structure of the dyadic interaction.

Objective 3: Following the study of economic indicators of construction industry in Xinjiang, Henan and Jiangsu and based on a structured survey in these three regions, the appropriateness and effectiveness of the study was evaluated by examining the process of dealing with construction method statement. The result of the study among the three regions has indicated strong correlation between knowledge transfer and economic development, which will be discussed in the Section of Research Findings of this Chapter. Furthermore, the process of knowledge transfer was further defined with the establishment of the concept and significance of tacit knowledge transfer.

Objective 4: The relationship between technology transfer and economic development was explored through the analyses of the data collected in the main study by using the correlation technique of Pearson's Product-Moment Correlation Coefficient. Moreover, implications of relationship between transfer of explicit and tacit knowledge have been identified. However, the following text will further explain the issues of aims and objectives of the current study and the research findings.

9.3 Research Findings

What is the relationship between knowledge transfer and economic development? Are they positively or negatively related, or is the relationship more complicated? Based on the data obtained from both the Pilot Study and the Main Study, this section will consider these questions.

9.3.1. Relationship between Knowledge Transfer and Economic Development

The study of construction activities with a comparison of the economic indicators among Jiangsu Province, Henan Province and Xinjiang Autonomous Region suggests a notional hierarchy of economic development. Jiangsu is at the higher level with Xinjiang at the lower level, and Henan is in the middle position. Analysis and comparison of the data collected from the three regions suggests that certain aspects of knowledge transfer is paralleled by the notional line of economic development. In other words, there are features of knowledge transfer that appear to be associated with levels of economic development. To put it differently, this relationship between knowledge transfer and economic development is positively effected. Figure 9.1 represents a simplified view of the relationship between knowledge transfer and economic growth. The arrow in the figure indicates that the demand for knowledge transfer grows as the economy increases.

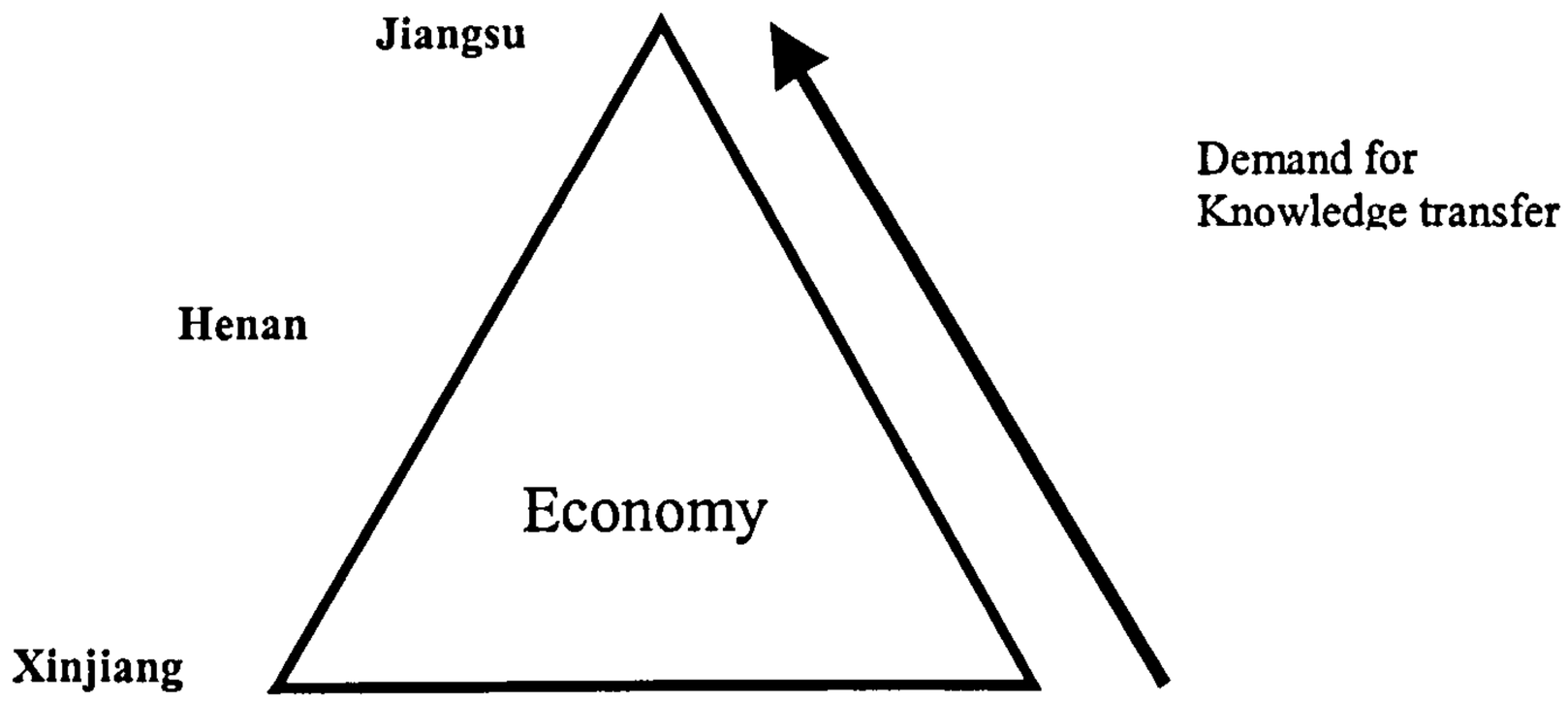


Figure 9.1. Relationship (notional hypotheses) between knowledge transfer and economic growth

In Chapter Eight (Table 8.4; Chart 2; Chart 3; Chart 5 & 6; Chart 13; Chart 18) the results showed clear relationships as presented in Figure 9.1. between aspects of knowledge transfer and the different levels of economic development as exemplified by the three regions under examination. These aspects are now connected in more details.

9.3.2. The Relationship between Transfer of Explicit Knowledge and Tacit Knowledge

A comparison based on economic indicators of the three regions suggests that in the well-developed region there is more demand for tacit knowledge transfer, while there is more demand for explicit knowledge transfer in the less developed region. In other words, people in the most-developed economies are keen to obtain tacit knowledge (soft knowledge), such as management know-how, while people in the least developed economies are keen to obtain explicit knowledge (hard technology), such as a specific technology to manufacture a product. Thus, the relationship between the need for tacit knowledge transfer and explicit knowledge transfer is X – Shaped. This is shown diagrammatically in Figure 9.2.

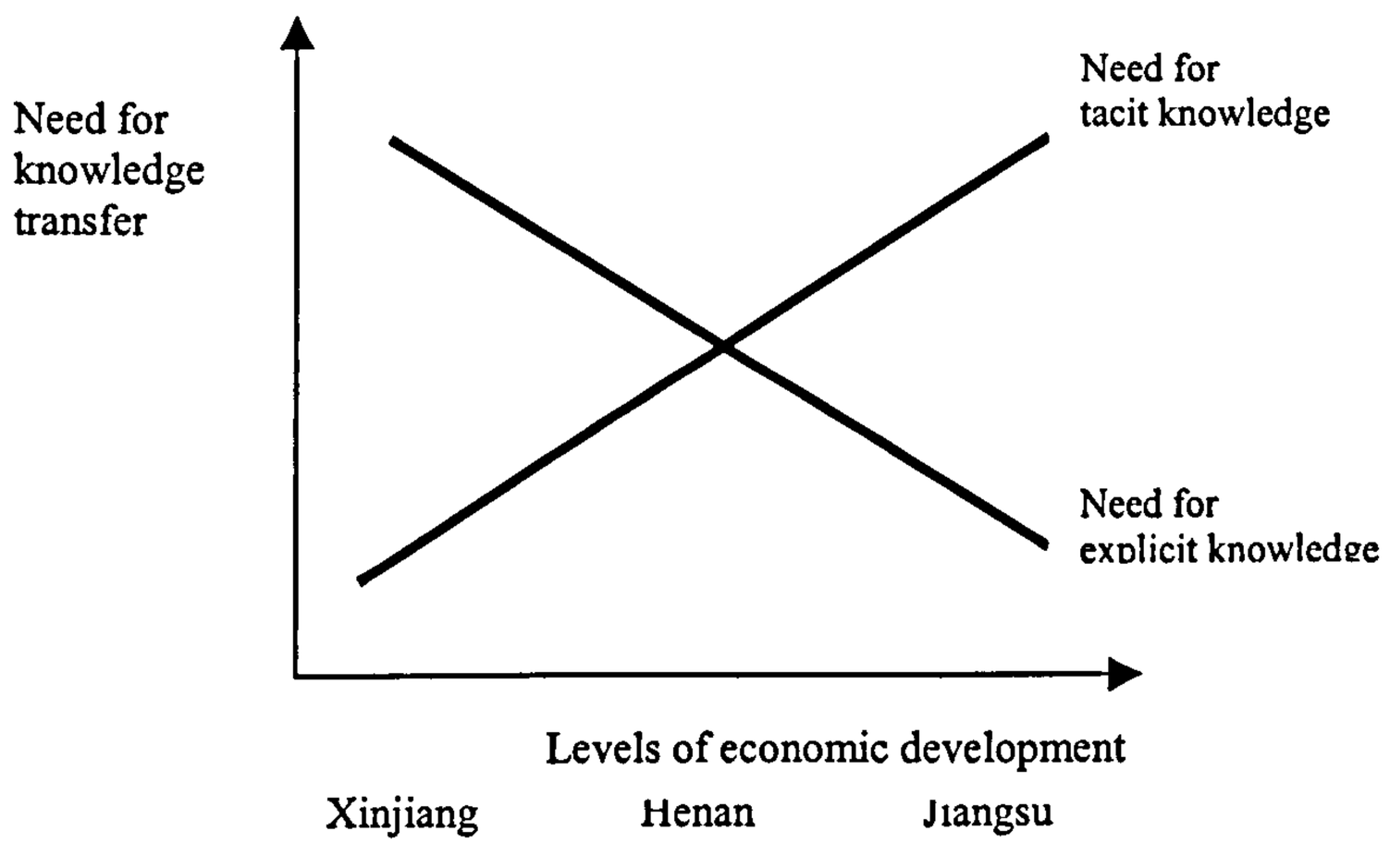


Figure 9.2. Relationship (notional hypotheses) between tacit knowledge transfer and explicit knowledge transfer

In Chapter Eight (page 140 Chart 7; page 141 Chart 9;) the results showed a clear relationship as presented in Figure 9.2. between tacit knowledge transfer and explicit knowledge transfer as exemplified by the three regions under examination.

Based on the above, it is suggested that the desire to obtain more tacit knowledge increases and the desire to obtain more explicit knowledge decreases with the levels of economic development. In other words, in a developing economy, people are more thirsty for explicit or hard knowledge, such as a specific technology to manufacture a product that enables people to survive than for tacit or soft knowledge, such as management know-how that enables an economy to have sustainable growth.

9.4. Systematic Approach to Tacit Knowledge Transfer

It has been recognised from the Pilot Study and the Main Study of the research project that tacit knowledge transfer is often blocked due to the very nature of that form of knowledge. However, as identified in the studies, there are certain channels of tacit knowledge transfer, such as, "telephonic communication", "social occasions", and "chance meeting at work" (refer to Figure 6.4.). This suggests that the channels of tacit knowledge transfer appear to work currently in a somewhat arbitrary manner. It is reasonable to suggest that the transfer of tacit knowledge can be more systematised. Figure 9.3 represents a systematic model of tacit knowledge transfer, where certain influencing factors, motivation and congruence of knowledge transfer have been highlighted (refer to Section 6.6.7 of Chapter Six and page 131 Chart 11 & 12 of Chapter Eight).

For those wishing to encourage the transfer of knowledge, it would be helpful to adopt a more systematic approach that deals with the multi-faceted aspects of knowledge transfer. Such a systematic approach would consider all available resources, constraints, relationships, motivators, influencing factors, channels and foreseeable contingencies as a part of a dynamic whole in order to arrive at the most effective and efficient means of meeting the knowledge transfer objectives. The successful implementation of knowledge transfer on a joint venture project requires an understanding of the objectives and the challenges facing the project's working

environment, and requires the application of conceptual skills, relevant and adequate systems, and information technology tools and concepts.

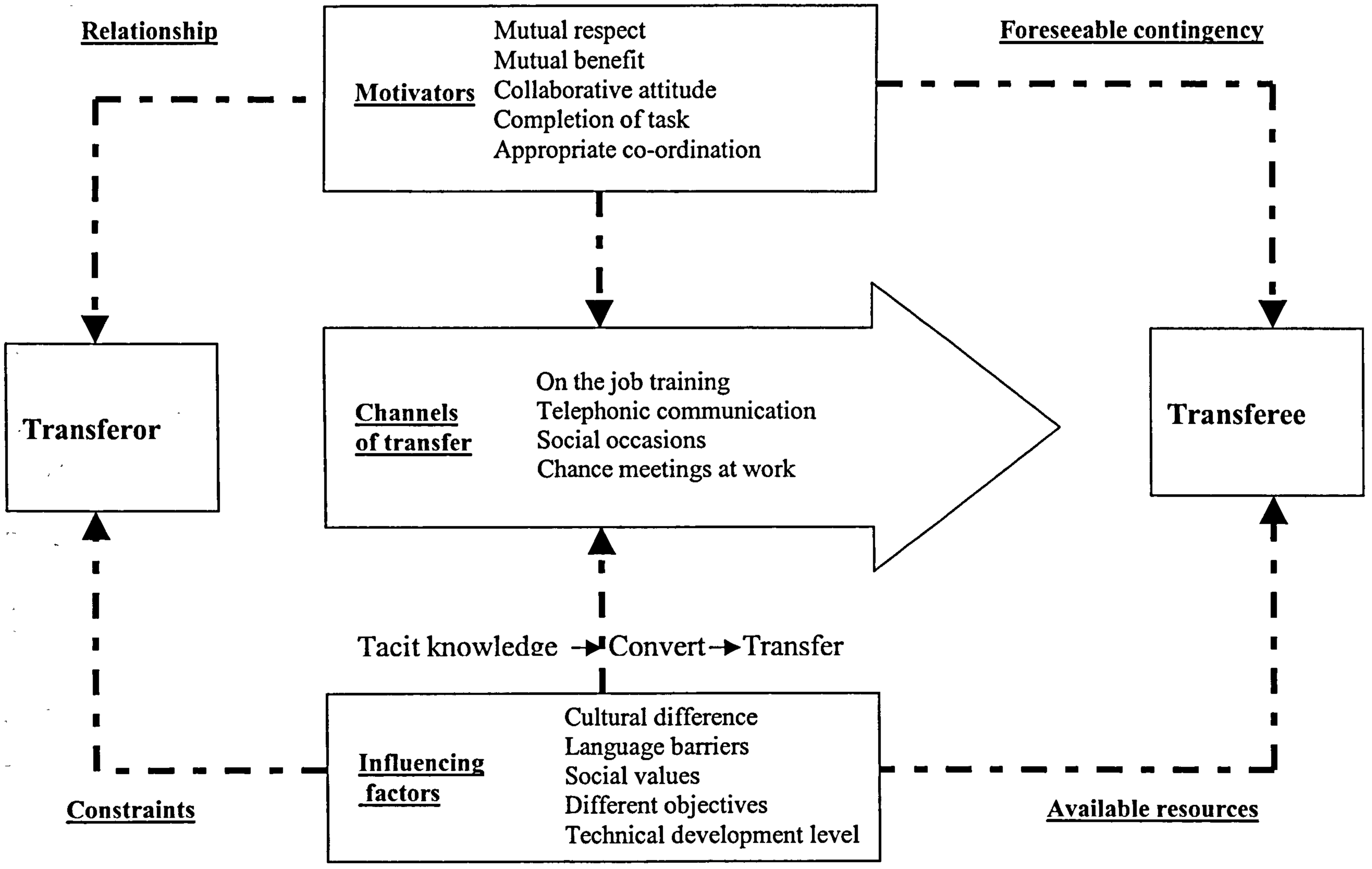


Figure 9.3. A model of tacit knowledge transfer

9.5. Effect of the Xiaolangdi Project on Responses from Henan

As previously established, the Xiaolangdi project was considered by the Chinese Government as an excellent example of the practice of international project management. During the implementation of the project, thousands of young engineers have been trained and have acquired both professional knowledge and management expertise. As Zhang (1997) pointed out, "it will be a great and an arduous task to assess the social and economic result of knowledge transfer in Xiaolangdi project. It is necessary to establish a research institute, which will promote international project management research and summarises the international project management experience of Xiaolangdi project in a systematic way and provide guidance in theory and practice in the future".

Appraisal of the teamwork of the Xiaolangdi Project by the current Deputy President of the World Bank has suggested the successful transfer of management know-how between the local and foreign partners. The collaborative attitudes of both foreign and local partners has been highly valued and appreciated. Xiaolangdi Project was completed quickly and effectively. Xiaolangdi Project was let under international competition. As far as the project is concerned, what the World Bank has brought in is not only the funding for the construction of the project itself, but also access to advanced technology and management expertise, which has created a platform for domestic and international contractors to have technical co-operation, technology transfer, and competition. Among all the projects founded by the World Bank, Xiaolangdi Project has been a particular success in terms of time, cost and quality. The great achievement of which has not only set up a good example in the hydro-power construction in China, but also has significance in the world (Gouna, 2000).

The analysis of the data, as it stands, from the beginning to the end of the main study shows that Henan Province is in a superior position in terms of various issues, such as attitude, interest, perspective and motivations towards knowledge transfer though the economic development level is in the intermediate position. Why Henan Province is always in a predominant position? (Refer to Chart 3, Chart 5, Chart 7, Chart 9, Chart 19 and Chart 20 of Chapter Eight). The most obvious interpretation is that the Xiaolangdi

Project itself has given significant impact to the Province. The Xiaolangdi Project, located in Henan Province, involved thousands of people (technical and administrative) from the Province during the implementation of the project. Local people and foreigners worked together for the common goal to achieve a successful project. When people were exposed to a certain culture or environment, the philosophy and the perspective and the way of thinking would be affected in a certain way [1]. This again proves that knowledge transfer did occur during the implementation of the project and the positive effect of knowledge transfer as well.

9.6. Implication for Policy and Practice

Knowledge transfer has been shown to be positively effected by the levels of economic development of the recipients. As discussed in the last chapter, in terms of the communication of method statement, there exists a large gap between Jiangsu, Henan and Xinjiang. In Jiangsu, construction people rarely use "verbal" mechanisms to communicate method statement; in Henan, construction people avoid "verbal". However, there is a strong tendency in Xinjiang for using the "verbal" mechanism rather than a "formal document"(Refer to Chart 2 of Chapter Eight). Knowledge transfer is a two-way process. However, it appears that construction people in Xinjiang feel there is "knowledge transfer from local to foreign" while construction people in Henan strongly believe that there is "knowledge transfer from foreign to local". Construction people in Jiangsu support the idea that knowledge transfer takes place from foreign to local.

Given the situation that joint venture is a preferred vehicle for technology transfer to China, it is reasonable to suggest that it would be wise and practical to promote the establishment of joint ventures between Xinjiang and Jiangsu, or between Xinjiang and Henan rather than to promote setting up joint ventures between, for example, Xinjiang and the western countries. Knowledge transfer is not obtainable if there is a too big gap

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In the study, the data were dealt in two ways. One set of data concerns Xiaolangdi in the context of Henan Province. Another set of data concerns Xiaolangdi Project separate from Henan Province. These two sets of data are attached as **Appendix 6** and **Appendix 7.**

in terms of economic development between transfer and transferee, despite the governments and funding agencies promote technology transfer. It appears that there are 20,500 Sino-foreign joint ventures in Jiangsu and 2000 Sino-foreign joint ventures in Henan, which are operating effectively and efficiently, while statistics show that there were Sino-foreign joint ventures in Xinjiang till 1998 (refer to Chapter Seven). Of course it has been recognised in the study that the joint ventures between Jiangsu, Henan and the West countries are effective approach for transferring technology and developing the economy.

9.7. Contribution to the Understanding of How Knowledge is Transferred

Because of the inability to meet the demands of economic growth from current indigenous resources, the Chinese construction industry relies on foreign investment in its various forms. This is a short-term measure, but in the long-term China seeks the additional benefit of sustainable technology transfer. There are various modes of international activity that could have an effect. Of these, international joint ventures appear to be the preferred vehicle for both the recipients in question - China - and of its major external funder of construction activity - the World Bank.

The potential is recognised by the World Bank. In 1993 the Bank adopted an explicit policy of requiring a commitment to technology transfer from its contractors to the construction industries of the host country. According to Abbott (1985), an essential condition for effecting such technology transfer is the clear specification of the requirement in a contract. The World Bank's policy in principle was that organisations should not be awarded contracts without forming meaningful partnerships with local companies. Despite the existence of the policy there appears to be few, if any mechanisms for ensuring that technology transfer has actually taken place or to measure its appropriateness and effectiveness. The World Bank has itself already recognised the difficulties in monitoring such a policy. Yet this deficiency results from the belief that there is something inherent in the technology that determines the effectiveness of transfer. This research supports the view that the nature of the technology is not a major factor. In fact, the field-work undertaken in China as part of

this research, gives a clear indication that it is quantity of knowledge transfer that predominantly affects the success of the technology transfer. In fact, it further appears that there is a pronounced effect in the relationship between the type of knowledge required and the technical development of the recipients. An important contribution of this research to the efficiency of the Chinese construction industry has been to analyse the components of knowledge transfer and determine how and why it is being inhibited. The tracking of *Method Statements* showed that in general, explicit knowledge is being readily transferred. However, it is the tacit knowledge that has been neglected. Results from the fieldwork showed clearly that there were no systematic channels for tacit knowledge transfer in place. This fact could have an adverse influence on the potential for inward technology transfer. Tacit knowledge has not even been recognised as an important factor and its transfer has been merely reliant on chance encounters. To improve its delivery, this study points out that a more systematic approach is required for tacit knowledge transfer.

Therefore, in association with the specification of technology transfer in a contract addressed by Abbott, the current research project has established a framework to specify the terms and conditions of technology transfer. Furthermore, the study has clearly defined that knowledge transfer is crucial during the process of technology transfer. Without knowledge transfer, technology transfer will not work.

9.7.1. Theoretical Contribution

This study has provided an original contribution towards an understanding of the process of technology transfer. In addition, this study has made a further investigation into the mechanisms of the tacit knowledge transfer between international joint venture partners. The pilot study, the main study and the evaluation of the research model for the present research, which were designed to take place within the context of three different economies in China, are coherently related, and therefore the aims and objectives of the research project have been achieved. It is believed that this cross-culture research with the application of a psychological methodology proves successful. From an academic point of view, the study has produced insights into the transfer of tacit knowledge that had not existed hitherto in an area that has attracted little previous research. The present research focuses on the way that technology transfer has

developed into knowledge transfer, in particular, tacit knowledge transfer, which is at the forefront of research in this area.

Furthermore, the relationship between knowledge transfer and economic growth and the relationship between explicit knowledge and tacit knowledge has provided further insights and grounding for the theorists and economists to address economic issues both at macro-economic and micro-economic levels.

9.7.2. Practical Contribution

It should be noted that this study has provided a useful contribution to tracking the process of technology transfer in practice. The distinctiveness of the research programme lies in that the understanding of tacit knowledge transfer, which has been developed and evaluated within the three different economies, will enable the recipients and donor organisations as well as international funding agencies to identify the essential ingredients of a particular aspect of technology transfer, namely the transfer of tacit knowledge. It is believed that the theoretical framework of the research may provide guidance and enable policy-makers within the governments, sponsors of projects and the executives of the companies involved to address the existing deficiencies in the process of technology transfer, and assist in development of more appropriate arrangement for the transfer of management knowledge.

9.8. Recommendations for Further Research

The boundary of the current research has been set within the context of construction industry in The People's Republic of China. However, the qualitative data has been collected followed by a comprehensive quantitative analysis and comparison. It is hoped that based on the advances made in the study, the practical assessment of management know-how and the further tracking the process of tacit knowledge can be approached in future research. Ideally, the sampling places for undertaking major studies would be three different economies in different countries, possibly representing advanced industrialised countries, newly developed countries and less developed countries, rather than three regions in China.

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Appendix 1: A Sample of Assessment Inventory for the Pilot Study

Date: 8th February 2000

Dear Respondent:

Subject: Knowledge Transfer in International Joint Venture Projects in China

The research aims to investigate the current mechanisms of technology transfer and the aspects of technology transfer between foreign and local partners within international joint ventures in China and to generate a model for its effectiveness. The results may ultimately assist in assessing the efficacy of technology transfer and may inform decision-makers in the recipient and donor organisations as well as investors such as the World Bank, who impose contractual provisions that require technology transfer.

The attached assessment inventories have been created to help identify the knowledge components, channels and motivations of knowledge transfer as well as influence factors of knowledge transfer between foreign partners and local partners through human interactions in the Sino-foreign joint ventures in China.

The assessment inventories have been designed with questions and answers ranging from 0 to 5 grades. You may tick from Grade 1 to Grade 5 if you agree with the researcher according to the degree of your agreement. Grade 0 represents your agreement with the author in principle, while Grade 5 represents your complete agreement with the researcher.

If you have any questions or you wish to contact the researcher for more information, please feel free to e-mail:**Richard.lihua@unn.ac.uk**. Also, you may contact us by telephone at: 00 44 191 227 3493 or by fax at:00 44 191 227 3167. Full confidentiality of your responses will be assured. We will be happy to share with you the compiled results of this survey.

Thank you in advance for your kind assistance and feedback you can provide. We are looking forward to hearing from you soon. Please respond by April 25, 2000, at the latest.

Regards

Richard Lihua
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The United Kingdom

Knowledge Transfer Assessment Inventory

Please give more details if you can besides the questions in the boxes.

T1

How do you rate technology components applied in the construction industry?	0	1	2	3	4	5
Hard technology Soft technology *Management know-how* *Explicit knowledge* *Tacit knowledge*						

T2

How do you evaluate the main responsibilities of a construction manager?	0	1	2	3	4	5
Difficulty-overcoming Problem identification Problem analysis Problem-solving Decision-making						

T3

How do consider the following channels of explicit knowledge transfer?	0	1	2	3	4	5
Conferences Meetings Seminars Training sessions Workshops						

T4

How do you consider the following channels of tacit knowledge transfer?	0	1	2	3	4	5
Toolbox talks Telephonic communications Social occasions Chance meetings at work Apprenticeships						

T5

How do you evaluate the following motivations of knowledge transfer?	0	1	2	3	4	5
Completion of the present construction work Having good partner in future work Showing collaborative attitude Win-win solution Mutual benefit						

T6

How do you think of the following skills of communications/interactions	0	1	2	3	4	5
Capitalise on your thought speed						
Behaviour description						
Listen patiently and without interruption						
Strive for clarification						
Feedback						

T7

How do you think of the following timing and regularity of dyadic interaction?	0	1	2	3	4	5
Meeting weekly						
Training sessions at the start of the project						
More toolbox talks daily						
More telephonic communications daily						
Meeting at social occasion weekly at the weekend						

T8

How do you evaluate the success of dyadic interaction?	0	1	2	3	4	5
Self-organising team						
Self-controlled time						
Self-arranged place						
Appropriate co-operation						
Appropriate co-ordination						

T9

How do you evaluate the purpose of dyadic interaction?	0	1	2	3	4	5
Solving a problem						
Overcoming a difficulty						
Making a decision						
Expressing satisfaction						
Learning from each other						

T10

How do you evaluate the influencing factors of knowledge transfer?	0	1	2	3	4	5
Cultural differences						
Language barriers						
Different objectives						
Social values						
Technical development level						

Appendix 2:Transcriptions of Interview in the Pilot Study

(1) Interview with
Mr. Friedrich Redie
Super Intendent
CGIC Joint Venture
Xiao Lang Di Multipurpose Dam Project
PRC

July, 1999

RLH: As I mentioned to you, technology transfer is very important issue in construction industry. The understanding is that there must be technology transfer between the developing countries and developed countries, especially now in international joint ventures. I assume that there is technology transfer or knowledge transfer between foreign partners and local partners. How do you think of these issues?

Redie: It is true.

RLH: OK., well is technology transfer free of charge? How do you deal with it when you do some transfer between you and your Chinese colleagues.

Redie: It is free.

RLH: So that is free. And why is it free?

Redie: It is free for the progress sacrifice and the completion of the project. As we are working for the same project. The early successful completion of the project is our common goal. As for that we are willing to transfer what they need for free of charge.

RLH: So, this is an important motivation.

Redie: Yea,yea! Most, Most,…….

RLH: It is the most important motivation for you transfer some knowledge to your Chinese partners.

Redie: Yes.

RLH: So Mr. Radie, can you please give me an example of how you transfer knowledge to your local Chinese partner?

Redie: I told you …….something technical oh….we call them know-how.

RLH: So, that is on day to day basis and most of the time, when you work with your Chinese colleagues and they may learn something from you.

Redie: Really they are expecting some kind of knowledge, in particular management know-how.

RLH: Could you please tell me that generally how long do you spend with your Chinese colleagues in this construction site. Could you tell how long do you stay in your office for one day? Just the average hours, for example, 8 working hours?

Redie: Most of the time. I spend half of the day in dealing with various problems.

RLH: what problems?

Redie: Both technical and administrative.

RLH: So that is around 4 hours. And how do you allocate the other time?

Redie: Not in this office, most of the time, we are on the construction site.

RLH: with the Chinese engineers?
Redie: Yes.
RLH: Do Chinese engineers come to your office from time to time.
Redie: Yes, they come to my office.
RLH: Do you have chances to be in their office?
Redie: Sometimes, I do.

RLH: So Mr. Redie, what I am assuming is that management know-how can be transferred over the telephone, do you believe it? Do you have such experience over the telephone?
Redie: Normally, if I tell them how to solve the problem if they phone me to ask for a specific inquiry. Sometimes, if I am not satisfied with their work, I will tell them over the telephone as well. However for the important issues, I will tell them personally face to face.
RLH: How do you think of the meetings? You know, sometimes you may have a site meeting to discuss some problem?
Redie: Yes, we do. Actually, the site meeting is very important for problem solving and decision making. You know, sometimes there is unexpected issue come out and you have to sort out as quickly as possible before proceeding any work.
RLH: Do you go to the construction site and tell people to solve problems.
Redie: Sometimes I have to go to the site to meet people and solve the problem on the spot.
RLH: OK. Are you satisfied with the performance of your Chinese partners?
Redie: More or less
RLH: So far so good?
Redie (nod his head): yeah.
RLH: If you make comparison, now and when you started work at the beginning, are you satisfied or were you satisfied with their performance?
Redie: Well, actually, I am satisfied with their work.
RLH: Yes, You are satisfied now, but were you satisfied before, I mean at the beginning when you started working together?
Redie: Well, I have been working with people from more than 20 countries.
RLH: Sorry, I mean on this construction site.
Redie: Yes, I am satisfied with their work. In general, Chinese people are easy people to work with.

RLH: Could you tell me when did you come to this construction site?
Redie: 1998
RLH: So you have been here more than one year already.
Redie: Yes.
RLH: I was here four years ago, and later I went to the UK to do my research. I used to be a consultant for some part of the project and haven't seen the site for long time. So you mentioned you have worked in many countries.
Redie: Yes, more than 20 countries.

RLH: That's wonderful. Ok, there is another question, I guess there must be some barriers when you work with your colleagues from another countries. I mean from your experience, do you have such feeling between you and your Chinese colleagues? Any what do you think the barriers come from?

Redie: Which kind of barriers do you mean?

RLH: Well, if you work with a Chinese engineer who can not speak English with you…

Redie: You mean the difficulties.

RLH: Yes.

Redie: Of course, there is, definitely. For me, the most significant problem is communication. A lot of, or even most of the Chinese engineers don't speak English. In addition, translation (interpretation), because of various personality etc. also cause difficulties. I can only transmit 70% of what I want to express.

RLH: So because of the language barrier, You can not pass what you want them to know and show them how to do things, there is difficulty.

Redie: Yes, there is a big language difficulty.

RLH: Have you ever find the culture difference. You know, the differences between the East and West? Sometimes, we call it culture shock.

Redie: Well, you know, I have been working for so many countries and become more internationalized, so I am very flexible and culture differences doesn't seem to be a problem for me.

RLH: So the difficulty that you think is the language barrier. Do you think that things may be better that if your partners are well educated and they can speak English and have more international experiences as you?

Redie: Comparing with the local partners who can not speak English and without international working experiences, the people who are well-educated and have more international experiences are preferred.

RLH: Have you found you learnt anything from your partners?

Redie: Sure, but not technical lesson. I learnt a lot about the national and local culture, the customs, habits, etc. but not in the sense of technology or technical side.

RLH: How about your colleague's attitude on technology transfer? Are they willing or eager to transfer the technology?

Redie: Sure. Yes, what we discussed at the beginning, the strong motivation for transferring technology is progress and success of the project. The only way to achieve this is to transfer technology, helping them, to work together, not to hide, otherwise, you can not be successful in completing your project.

RLH: I think the relationship between the Foreign and Local partners is just like a marriage. Since you married, that means, you have to do the best to keep the relationship and to achieve the target.

Redie: Yes, absolutely right. We have to make effort to keep the relationship until the divorce.

RLH: Could you tell me when you train the local partners, what your mechanisms is? How do you train them? A form lesson, a training class?

Redie: We just come together and I explain the best way to do it. It's not a one-stop training, it's a daily work from office to the construction site. Because I don't have too much time, just start the work, during the work, I find problem and tell them how to do. It's a long way, but the best way, you know, is through practices. And you can be successful.

RLH: Yes, I agree with you. Did you do the same when you worked in the other countries apart from China?

Redie: Yes, when I worked in Africa I did the same thing before I came to China.

RLH: Thank you very much, Mr. Redie.

(2) Interview with
Mr. Han Zonghai
Director, Senior Engineer
Foreign Affairs Department
Yellow River water & Hydropower Development Corporation
Ministry of Water & Electricity
PRC

July 1999

Chinese Version:

李（Li）： 韩处长，

上一次我们谈到技术转让的问题，因为这是一个比较大的范围，今天我想就这一问题在更深一步的基础上与您探讨。我们目前所谈到的技术转让，基本上来讲有两种类型的技术转让， 一种我们称之为硬技术 hard technology, like construction technology 另一种我们称之为软技术, soft technology, such as, management know-how,

也称为管理技巧。目前我的研究着重在于探讨建筑业管理技巧的转让。比如，在小浪底这个项目上，大家都认为来自各个国家的专家将一些管理技巧转移到了中国的合作伙伴。当然，他们也从中国人这里学到了很多东西。我现在想向您请教的一点是，关于这种管理技巧的范例以及它是如何转移的。

韩（Han）：小浪底工程是一个大型的水力，水电工程，是由世界银行贷款，承包商来自世界各国，他们施工技术比较发达，管理手段比较先进。如德国，法国，意大利等国。从技术转让这个大的课题上讲，分为硬技术和软技术。软技术，又称为管理技巧，实际上在设计阶段就有，在设计阶段，它更多的是涉及到技术本身也就包括设计管理。

我于1997年在加拿大参加项目管理培训开始接触设计管理这个概念。在中国，因为（engineering）被认为只是工程，我们刚开始也听不懂，后来明白engineering在这里是主要是指工程的设计，engineering management or engineering control
主要是指设计管理，设计管理主要涉及到整个项目的分解，WBS，
根据工作的分解然后进行资源的配制。然后再有一个工作的计划，什么时候出什么样的图，什么时候完成什么样的工作，那么根据事先所分配的工作及工作的计划来控制设计工作的进程。这也是一种管理的技巧。

这种技巧在小浪底工程中涉及到一些，但是并不是很明显。在小浪底工程中的技术转让主要体现为技术本身的转让。前期主要包括一些咨询专家在设计院所进行的工作。对于施工这一块，所涉及到的管理技巧，也就是你所讲的管理技巧转让发生较多。通过电话，对话，会议，现场指导以及通过合同管理，我们向外国人学到了很多，而外国人从我们这里也学到了很多。

从水力，水电本身来讲，中国的水力，水电技术还是比较先进的。我们的技术人员并不比其它国家的差，但是问题在于，如果这项工程只由国内人员干，能不能干？而且能不能干好？答案是，我们能干，这是毫无疑问的，但是第二个问题，能不能干好？是由多方面的因素所制约。如果资金到位，领导重视，我们有这个能力干好，问题往往不在中国技术人员本身，往往做不好是因为管理问题。小浪底引进外商，我们在管理上学到了许多东西，这是最大的收获。外商的管理严格按照规程，规范，工序各方面的要求，有一整套管理程序。甚至包括日常的交往，会议，时间的限制，在他们一起工作这就要求中国的建筑队伍必须尊遁严格的管理制度，否则便会引起外方提出资金方面的索赔。比如说施工当中的缺陷处理，中国人对质量问题还是很认真的，但是有时管理的程序不到位。往往漏洞很多，从管理的角度来讲，横向应该是到边的，纵向应该是到底的，尽管领导很重视，技术人员很认真，但是因为管理程序复盖不到，使得某些方面成了被遗忘的角落。外商从管理技巧和管理方式上为中国的管理输入了新的血液，对于中方的工作人员来讲，从开始的不习惯到现在的习惯。这种观念上的接受应该说对于中国的水电的基本建设来讲是有一定的贡献的。

李（Li）：

我们承认在这个项目中是有技术转让的，特别是管理技巧，我想问一下你认为他们是怎么转让的?

韩（Han）：

根据我的观察，主要有两个方面，一方面是主动接受转让，比如说在日常工作耳濡目染，学习到管理技巧。

李（Li）： 他们有一定的时间在一起吗?

韩（Han）： 是的。几乎是在上班时都在一起，他们在同一间办公室。

另外一方面，是被动的接受转让。这是由于中国人自身的特点所决定的，中国人有很强的自尊心，不希望被外国人检查到工作上的问题，故此在工作方面严格按照外方的要求，因而逐渐接受外方的管理模式和方法。久而久之，中国人掌握到了西方的管理技巧。

李（Li）： 谢谢。

English Version (Translation)

Li: Mr.Han, I know that technology transfer is a large topic as we discussed last time. However, I would like to further discuss this issue. There are two types of technology transfer in general. One is called hard technology transfer, for example, construction technology; the other is called soft technology transfer, for example, management know-how. The focus of my research aims at transfer process of management know-how in the construction industry. Take Xiaolangdi for example, the understanding is that the foreign experts from the West have transferred certain knowledge

to the Chinese partners, and vise versa. What I want to know from you is whether there are examples of technology transfer and how was management know-how transferred.

Mr.Han: Xiaolangdi Project is a large hydraulic and power project, which has been partly financed by the World Bank. The contractors came from all over the world, especially from Europe. Their construction technology is well developed with advanced management expertise. For example, contractors from Germany, France and Italy. In terms of technology transfer, there are two items, that is hard technology and soft technology, I call it management know-how. It exists from the design phase. During the design phase, it involves design management.

I came to know the concept of design management when I had the project management training in Canada in 1997. In China, we regard "engineering" as project itself. As a matter of fact, "engineering" means "engineering management" or "engineering control". This covers the whole process of designing and completing the project. When to finish the design and when to finish the construction has been scheduled in a plan. This is management know-how.

It is not obvious that knowledge was transferred in terms of design management. However, the transfer of management know-how take place from time to time during the construction of the project. The channel of transfer are "by telephone", "interaction or conversation", "through meetings" or "through contract management". We have learned a lot from foreigners and they learned a lot from us as well.

In terms of the construction of hydraulic and power project, the Chinese construction force is able to do and complete it without any difficulties as the hydraulic and power technology in China is fairly advanced. If you ask whether the Chinese engineers are able to do the job, the answer is "yes". If you ask whether the Chinese engineers are able to do the job well, this will be a complicated answer. Management itself will contribute a lot to the question. It is an important achievement to introduce foreigners to the Xiaolangdi project. They have brought management expertise along with them when they work in Xiaolangdi.

Foreign contractors have a strict and systematic management procedure in terms of construction, which covers daily communication, meetings, etc. Working together with foreigners, the Chinese construction force has to learn from them. They have to work in the way through which the foreigners do. Otherwise, there will be claims against the Chinese side. The foreign experts have brought new blood to the Chinese management system. The Chinese engineers and workers learn to become familiar with the advanced management system gradually. The conceptually acceptation of the scientific management system is a contribution to the construction of the Chinese hydraulic and power engineering.

Li: I understand from what you have been talking that technology transfer occurs from time to time in Xiaolangdi. Could you explain to me how was it transferred?

Han: As my observation, there are two dimensions. One is called active way, the other is called passive way. In an active way, people are willing to accept technology transfer. In a passive way, people are afraid of losing face, to be looked down, they have to learn and accept new knowledge, otherwise, the worst will be that there might be claim against them.

Li: Do foreigners and Chinese engineers have sufficient time to work together?

Han: They work in the same office.

Li: Thank you

Appendix 3 Background Information of Xiaolangdi Project

1. The signing ceremony of contract for Xiaolangdi Project taking place at the Diaoyutai State Guest House, Beijing, on 16th July, 1994. The project is partly financed by the World Bank.

2. Foreigners and locals working together

3. A birds eye view of Xiaolangdi multi-purpose dam project.

Appendix 4: A Summary of Assessment Inventory of the Pilot Study

Questions	Answers	Answer rate %	Total responses (52)
1.Why did you need to determine the method statement?	Method statement is important for the guarantee of quality, time and cost of the project This is in accordance with the requirement of the contract This is in accordance with IS09001 Method statement is very effective Method statement is needed for the resource allocation For the satisfaction of the client For health and safety It helps to solve the construction problems For the administration of the contract		
2.What is the form of the method statement?	Formal document Informal document and others	50 50	52
3. Who has the final say in terms of method statement?	Local partner Foreign partner Together	17 21 60	52
4. Who were the parties mainly involved in the execution of the method statement?	Both local and foreign partners	96	52
5. What was the form of method statement based upon?	Contract document	75	52
6 What knowledge needed to transfer between foreign and local partners?	Management know-how Construction knowledge	84 16	52
7. What knowledge needed to transfer between foreign and local partners?	Tacit knowledge Explicit knowledge	73 27	52
8. In what way was the tacit knowledge transferred?	Toolbox talks Telephonic communication Social occasions	All confirmed	52

	Chance meeting at work		
9. In what way was the explicit knowledge transferred?	Conferences Meetings Seminars Training sessions	All confirmed	52
10. What was the patterns of knowledge transfer?	From foreign to Local From Local to foreign Two way process	7 3 90	52
11.What critical issues were resolved in the discussion of method statement?	Cost Time Quality Safety		52
12. What happened to the method statement after the discussion by both parties?	The method statement was revised	98	
13. If the method statement was revised or rejected, how was the actual method statement devised?	By the local By the foreigner By compromise	30 3 67	
14. How was the work being carried out with revised method statement?	Normally Better	16 84	

Appendix 5: Assessment Inventory in the Main Study (English Version)

METHOD OF WORKING
- RESEARCH PROJECT

POSITION OF RESPONDENT: CONSULTING ENGINEER DATE: NOV. 22/2000

ANSWER TO MOST OF THE QUESTION WILL DEPEND ON THE CONTRACTUAL POSITION OF THE FOREIGN MANAGER i.e., HE IS

DEAR RESPONDENT: EITHER PART OF THE "ENGINEER'S" ORGANISATION OR HE IS ADVISOR. ASSUME THAT HE IS PART OF THE ORGAN.

My research interest is how solutions to construction problems are resolved. I would like to have your help in determining the interaction between local and foreign managers. To focus the process, I would like you to consider a particular building task, where you needed to determine the method. Was there a formal method statement or did you devise your own informal schedule, sketch or notes? Could you please choose one answer and tick the appropriate box to the following questions and if possible add a few notes to explain what actually happened after each question?

1. **Why did you need to determine the method?**

   NO WORK SHALL BE DONE WITHOUT METHOD STATEMENT

2. **How did you communicate the method statement?**
   (from now on I will call this the 'method statement')

   ☒ Formal document ☐ Sketch or note ☐ Verbal

3. **What was the form of method statement mainly based upon?**

   ☐ Copy of handbook ☐ Previous method statement
   ☒ Contract document ☐ Hand made on the spot

4. **What was the main reason that a method statement was needed for the task?**

   ☐ Complicated task ☐ Resource allocation
   ☒ Guidance of work ☐ Required by the client

5. **Which party had the final say in terms of method statement?**

   ☐ Local. ☐ Foreign. ☒ Together.

6. **Which party was mainly involved in the process of discussing method statement?**

   ☐ Local. ☐ Foreign. ☒ Together.

7. **What was the main type of knowledge <u>that needed to flow</u> between foreign and local managers?**

☒ Construction technology ☐ Management know-how

8. **What was the main type of knowledge <u>that actually did flow</u> between foreign and local managers?**

☒ Construction technology ☐ Management know-how

9. **What was the main type of knowledge <u>that needed to flow</u> between foreign and local managers?**

☒ Explicit knowledge (e.g. codified) ☐ Tacit knowledge (e.g. uncodified)

10. **What was the main type of knowledge <u>that actually did flow</u> between foreign and local managers?**

☒ Explicit knowledge ☐ Tacit knowledge

11. **What was the main channel of explicit knowledge transfer?**

☐ Conferences ☒ Meetings ☐ Seminars ☐ Training sessions

12. **What was the main channel of tacit knowledge transfer?**

☒ On the job training ☐ Telephonic communication
☐ Social occasions ☐ Chance meetings at work

13. **What was the principal pattern of knowledge transfer?**

☐ Foreign → Local ☐ Local → Foreign ☒ Two way-process

14. **What is the main influencing factor of knowledge transfer?**

☐ Culture ☐ Language ☒ Common objective ☐ Social values

15. What is the primary factor in achieving successful knowledge transfer?

☐ Mutual respect ☒ Close co-operation ☐ Appropriate co-ordination

16. What is the principal motivator in achieving successful knowledge transfer?

☐ Mutual benefit ☐ Collaborative attitude ☒ Completion of task

17. What principal issue was resolved in the discussion of method statement?

☐ Time ☐ Cost ☐ Safety ☒ Quality

18. What mainly happened to the method statement after the discussion by both parties?

☒ Implemented ☐ Revised ☐ Rejected

19. If this method statement was revised or rejected how was the actual method statement devised?

☐ By the local ☐ By the foreigner ☒ By compromise ☐ By a third party

20. How was the work being carried out with the revised method statement?

☐ Normally ☒ Better

THANKS.

RICHARD LI HUA
PHD RESEARCHER
UNIVERSITY OF NORTHUMBRIA AT NEWCASTLE
NEWCASTLE UPON TYNE
THE UNITED KINGDOM

16TH OCTOBER, 2000

Appendix 5: Assessment Inventory in the Main Study (Chinese Version)

中外合作伙伴有效的工作方案
（英国诺森堡大学科研项目）

日期：21/11-2000　应答人职务：高级工程师

尊敬的应答人：

我的研究兴趣在于如何谋求解决建筑业问题的办法。我真诚地希望您能够帮助我探索中外管理人员进行密切交往的奥妙。我想请您设想一项特殊的建筑任务，在实施这项任务的过程中，您需要确定这种解决建筑问题的办法。您是使用正式的施工方案还是按自己的方式考虑非正式的施工方案，画一张草图或使用一张只言片语的小纸条。请您针对下列问题选择一个您认为最适合的答案并在其方框内打勾。如果可能的话，请您对实际发生的情况在每一个问题后作进一步说明。

1、在实施这项特殊的建筑任务中，您为什么需要确定这种方法？

~~确定这种方法是为了明确，更加明确，可以使所有~~

2、在使用这种方法时，您是利用何种方式进行沟通的？（从现在开始，我将称这种方法为施工方案）

☑ 正式文件　☐ 便条或草图　☐ 口头方式

重要工程项目或重要部分项（单项）必须以正式文件为准。

3、施工方案形成的主要基础是什么？

☐ 施工手册　☐ 先前的施工方案　☑ 合同文件　☐ 现场草拟

合同是项目管理的基础，超出合同范围特殊应对变化！

4、选择这项施工方案的首要原因是什么？

☐ 任务复杂　☐ 资源分配　☐ 工作指南　☑ 业主要求

要体现业主意志。

5、就施工方案而论，哪一方拥有最终决定权？

☑ 中方技术人员　☐ 外方技术人员　☐ 双方共同决定

确定方案往往是双方共同讨论，但决定时，由中方（业方）决定。

6、在实施施工方案的过程中，主要涉及哪些人员？

☐ 中方技术人员　☑ 外方技术人员　☐ 涉及双方技术人员

因为外方是承包者，他双方都会涉及是必要的。

7、在中外合作双方实施项目的过程中，主要需要何种知识转移？

☐ 施工技术　☑ 管理技巧

实践证明中方我们人员的技术能力和机械也是可以的。

8、 在中外合作双方实施项目的过程中，实际转移的是何种知识？

☐ 施工技术　　☑ 管理技巧

外方的管理技巧和管理方法传给中方人员学习。

9、在中外合作双方实施项目的过程中，主要需要何种知识转移？

☑ 显性知识：例如可以通过书面文件进行沟通的知识

☑ 隐性知识：例如隐藏在人们头脑中的知识

隐性知识也多人的主观，并非常留意。

10、在中外合作双方实施项目的过程中，实际转移的是何种知识？

☑ 显性知识

☑ 隐性知识

~~在相互交流合作过程中，隐性知识也会有意无意的转移，这是不能不重视的。~~

11、显性知识转移的主要渠道是什么？

☑ 通过正式会议　☐ 小型座谈　☐ 研讨会　☐ 培训课程

~~渠道是多方面的，除了正式会议外，研讨会，交流会，座谈，联欢等的非都可以是知识转移的渠道。~~

12、隐性知识转移的主要渠道是什么？

☐ 现场培训　☐ 电话沟通　☑ 社交场合　☐ 工作偶遇

隐藏在头脑中的东西只有在相互接触中表露出来。

13、知识转移的首要模式是什么？

☑ 外方技术人员→中方技术人员　☐ 中方技术人员→外方技术人员　☑ 双向转移

~~双方转移的模式也是有的，中外双方各取所长。~~

14、知识转移的关键影响因素是什么？

☑ 文化　☐ 语言　☐ 目标　☑ 社会价值

外国人与中国人所重视观和文化观念有差异。

15、知识转移成功的首要因素是什么？

☐ 相互尊重　☑ 密切合作　☐ 适当协调

真诚合作，密切配合。

16、知识转移成功的重要促进因素是什么？

☑ 双方利益　☐ 合作态度　☐ 完成任务

17、在反复蹉商施工方案的过程中所涉及的关键问题是什么？

☐ 工期　☐ 成本　☐ 安全　☑ 质量

有时为了取双赢的决定，如既要好的质量，还必须保证工期，对承包商而言当然完成越快，但必须在保证合同要求的质量和工期的前提下维护成本利益。

18、中外双方蹉商施工方案后，最终结果如何？

☑ 原施工方案得到实施　☐ 原施工方案得到修定　☐ 原施工方案被推翻

已确定的方案是对双方的约束，是不得随意决定和推翻的。

19、假定原施工方案被修订或被推翻，那么实际实施的施工方案是如何拟定的？

☐ 中方人员拟定　☐ 外方人员拟定　☑ 双方妥协　☐ 第三方拟定

~~如果原定方案的决定，必须经过修改，但要双方协商确定，必要时双方都可能作出妥协。~~

20、按照修订后的施工方案，工程进展如何？

☑ 正常　☑ 较以前好

修定后的方案已得到了很好的实施，进展速度也很快。

英国诺森堡大学研究员

李华

2000 年 10 月 16 日

Appendix 6: A Summary of the Main Study Data from Jiangsu, Henan, Xinjiang and Xiaolangdi Project, PRC. (with Xiaolangdi outside Henan)

Total respondents and total copies received:450 copies

Questions	Answers					Total
		Xiaolangdi (61 cps)	Jiangsu (161cps)	Henan (128cps)	Xinjiang (100cps)	
A. General Information						
Q1. Why did you need to determine the method?	This is an open question.					
		60	163	115	101	
Q2. How did you communicate the method statement?	Formal document	78.33%	65.64%	42.61%	41.58%	55.81%
	Sketch or note	16.67%	19.63%	56.52%	32.67%	31.89%
	Verbal	5.00%	14.72%	0.87%	25.74%	12.30%
Q3. What was the form of method statement mainly based upon?						
		52	156	108	100	
	Copy of handbook	17.31%	22.44%	14.81%	9.00%	16.59%
	Previous MS	15.38%	16.67%	16.10%	25.00%	18.27%
	Contract document	63.46%	55.77%	53.00%	45.00%	53.37%
	Handmade on spot	3.85%	5.13%	16.10%	21.00%	11.54%
Q4. What was the main reason that a method statement was needed						
		78	162	107	100	
	Complicated task	6.41%	18.52%	3.74%	4.00%	9.62%
	Resource allocation	26.92%	36.42%	33.64%	51.00%	37.36%

for the task?	Guidance of work	11.54%	25.93%	11.21%	17.00%	17.90%
	Required by client	55.13%	19.14%	51.40%	28.00%	35.12%
		60	165	131	100	
Q5. Which party had the final say in terms of method statemnet?	Local	5.00%	16.97%	4.58%	22.00%	12.94%
	Foreign	10.00%	24.85%	3.05%	30.00%	17.76%
	Together	85.00%	58.18%	58.00%	48.00%	59.21%
		63	166	129	98	
Q6. Which party was mainly involved in the process of discussing method statement?	Local	1.59%	7.83%	30.75%	13.27%	14.35%
	Foreign	6.35%	16.87%	12.25%	30.61%	16.74%
	Together	92.06%	75.30%	57.00%	56.12%	67.61%

B. What is Transferred?

		59	157	114	101	
Q7. What was the main type of knowledge <u>that needed to flow</u> between foreign and local managers?	Construction technology	16.95%	16.56%	15.79%	30.69%	19.72%
	Management knowhow	83.05%	83.44%	84.21%	69.31%	80.28%
		57	157	121	99	
Q8. What was the main type of knowledge <u>that actually did flow</u> between foreign and local managers?	Construction technology	21.05%	33.12%	33.70%	31.31%	31.11%
	Management knowhow	78.95%	66.88%	66.30%	68.69%	68.66%
		58	151	129	102	
Q9. What was the main type of knowledge <u>that needed to flow</u> between foreign and local managers?	Explicit knowledge	25.86%	33.77%	68.22%	50.98%	46.82%
	Tacit Knowledge	74.14%	66.23%	31.78%	49.02%	53.18%
		57	156	118	95	
Q10. What was the main type of	Explicit knowledge	28.07%	48.08%	51.64%	46.32%	45.77%

knowledge that actually did flow between foreign and local managers?	Tacit Knowledge	71.93%	51.92%	48.36%	53.68%	53.99%

C. How was knowledge transferred?

Q11. What was the main channel of explicit knowledge transfer?		51	151	114	98	
	Conferences	41.18%	29.80%	20.18%	30.61%	29.95%
	Meetings	35.29%	30.46%	53.51%	13.27%	33.33%
	Seminars	13.73%	27.81%	14.04%	50.00%	27.54%
	Training sessions	9.80%	11.92%	12.28%	6.12%	10.39%
Q12. What was the main channel of tacit knowledge transfer?		49	140	117	99	
	Job training	32.65%	17.86%	40.00%	12.12%	24.44%
	Telephonic communication	16.33%	22.14%	19.23%	22.22%	20.49%
	Social occasions	26.53%	39.29%	20.51%	53.54%	35.80%
	Chance meeting	24.49%	20.71%	20.26%	12.12%	18.77%
Q13. What was the principal pattern of knowledge transfer?		61	164	130	99	
	Foreign to local	11.48%	28.66%	53.85%	28.28%	33.48%
	Local to foreign	3.28%	14.63%	7.69%	33.33%	15.20%
	Two way process	85.25%	56.71%	38.46%	38.38%	51.32%

D. Success of Knowledge Transfer

Q14. What was the main influencing factor of knowledge transfer?		56	151	120	99	
	Culture	26.79%	9.93%	13.33%	32.32%	18.31%
	Language	21.43%	30.46%	75.83%	25.25%	40.85%
	Common objective	28.57%	36.42%	5.00%	14.14%	21.36%
	Social values	23.21%	23.18%	5.83%	28.28%	19.48%
		55	160	115	96	

Q15. What was the primary factor in achieving successful knowledge transfer?	Mutual respect	34.55%	18.13%	35.65%	35.42%	28.87%
	Close co-operation	61.82%	60.63%	46.96%	48.96%	54.46%
	Appropriate coordination	3.64%	21.25%	17.39%	15.63%	16.67%
		55	152	119	130	
Q16. What was the principal motivator in achieving successful knowledge transfer?	Mutual benefit	43.64%	44.74%	24.37%	40.00%	37.94%
	Colaborative attitude	32.73%	41.45%	24.37%	36.15%	34.43%
	Completion of task	23.64%	13.82%	51.26%	23.85%	27.63%

E. Key and Critical Issues

		35	77	104	99	
Q17. What principal issue was resolved in the discussion of method statement?	Time	34.29%	11.69%	2.88%	5.05%	9.21%
	Cost	31.43%	22.08%	17.31%	23.23%	21.90%
	Safety	11.43%	28.57%	36.54%	35.35%	31.43%
	Quality	51.43%	37.66%	43.27%	36.36%	40.63%

F. Aftermath of Knowledge Transfer

		61	165	129	100	
Q18. What mainly happened to the method statement after discussion by both parties?	Implemented	14.75%	13.33%	17.05%	21.00%	16.26%
	Revised	85.25%	83.64%	61.24%	69.00%	74.29%
	Rejected	0.00%	3.03%	21.71%	10.00%	9.45%
		61	164	129	95	
Q19. If this method statement was revised or rejected how was the actual method statement devised?	By the local	4.92%	18.29%	10.75%	12.63%	12.92%
	By the foreigner	6.56%	15.24%	14.55%	28.42%	16.48%
	By compromise	81.97%	61.59%	55.00%	48.42%	59.47%
	By a third party	6.56%	4.88%	19.70%	10.53%	10.47%

		62	164	129	100	
Q20. How was the work being carried out with the revised MS?	Normally	9.68%	29.88%	34.88%	29.00%	28.35%
	Better	90.32%	70.12%	65.12%	71.00%	71.65%

Note: Main Study Data with Xiaolangdi being separate from Henan.

Appendix 7: A Summary of the Main Study Data from Jiangsu, Henan and Xinjiang, PRC (with Xiaolangdi inside Henan)

Total respondents and total copies received:450 copies

Questions	Answers	With one answer			Total
		Jiangsu (161cps)	Henan (189cps)	Xinjiang (100cps)	
A. General Information					
Q1. Why did you need to determine the method?					
Q2. How did you communicate the method statement?		163	175	101	
	Formal document	65.64%	54.86%	41.58%	55.81%
	Sketch or note	19.63%	42.86%	32.67%	31.89%
	Verbal	14.72%	2.29%	25.74%	12.30%
Q3. What was the form of method statement mainly based upon?					
		156	160	100	
	Copy of handbook	22.44%	15.63%	9.00%	16.59%
	Previous MS	16.67%	15.86%	25.00%	18.27%
	Contract document	55.77%	56.40%	45.00%	53.37%
	Handmade on spot	5.13%	12.11%	21.00%	11.54%
Q4. What was the main reason that a method statement was needed for the task?					
		162	185	100	
	Complicated task	18.52%	4.86%	4.00%	9.62%
	Resource allocation	36.42%	30.81%	51.00%	37.36%
	Guidance of work	25.93%	11.35%	17.00%	17.90%
	Required by client	19.14%	52.97%	28.00%	35.12%
		165	191	100	

Q5. Which party had the final say in terms of method statemnet?	Local	16.97%	12.04%	22.00%	12.94%
	Foreign	24.85%	21.47%	30.00%	17.76%
	Together	58.18%	66.49%	48.00%	59.21%
		166	192	98	
Q6. Which party was mainly involved in the process of discussing method statement?	Local	7.83%	21.18%	13.27%	14.35%
	Foreign	16.87%	10.31%	30.61%	16.74%
	Together	75.30%	68.51%	56.12%	67.61%

B. What is Transferred?

		157	173	101	
Q7. What was the main type of knowledge <u>that needed to flow</u> between foreign and local managers?	Construction technology	16.56%	16.18%	30.69%	19.72%
	Management knowhow	83.44%	83.82%	69.31%	80.28%
		157	178	99	
Q8. What was the main type of knowledge <u>that actually did flow</u> between foreign and local managers?	Construction technology	33.12%	29.65%	31.31%	31.11%
	Management knowhow	66.88%	70.35%	68.69%	68.66%
		151	187	102	
Q9. What was the main type of knowledge <u>that needed to flow</u> between foreign and local managers?	Explicit knowledge	33.77%	55.08%	50.98%	46.82%
	Tacit Knowledge	66.23%	44.92%	49.02%	53.18%
		156	175	95	
Q10. What was the main type of knowledge <u>that actually did flow</u> between foreign and local managers?	Explicit knowledge	48.08%	43.97%	46.32%	45.77%
	Tacit Knowledge	51.92%	56.03%	53.68%	53.99%

C. How was knowledge transferred?

		151	165	98	

Q11. What was the main channel of explicit knowledge transfer?	Conferences	29.80%	26.67%	30.61%	29.95%
	Meetings	30.46%	47.88%	13.27%	33.33%
	Seminars	27.81%	13.94%	50.00%	27.54%
	Training sessions	11.92%	11.52%	6.12%	10.39%
		140	166	99	
Q12. What was the main channel of tacit knowledge transfer?	Job training	17.86%	37.83%	12.12%	24.44%
	Telephonic communicatic	22.14%	18.37%	22.22%	20.49%
	Social occasions	39.29%	22.29%	53.54%	35.80%
	Chance meeting	20.71%	21.51%	12.12%	18.77%
		164	191	99	
Q13. What was the principal pattern of knowledge transfer?	Foreign to local	28.66%	40.31%	28.28%	33.48%
	Local to foreign	14.63%	6.28%	33.33%	15.20%
	Two way process	56.71%	53.40%	38.38%	51.32%

D. Success of Knowledge Transfer

		151	176	99	
Q14. What was the main influencing factor of knowledge transfer?	Culture	9.93%	17.61%	32.32%	18.31%
	Language	30.46%	58.52%	25.25%	40.85%
	Common objective	36.42%	12.50%	14.14%	21.36%
	Social values	23.18%	11.36%	28.28%	19.48%
		160	170	96	
Q15. What was the primary factor in achieving successful knowledge transfer?	Mutual respect	18.13%	35.29%	35.42%	28.87%
	Close co-operation	60.63%	51.76%	48.96%	54.46%
	Appropriate coordination	21.25%	12.94%	15.63%	16.67%
		152	174	130	

Q16. What was the principal motivator in achieving successful knowledge transfer?	Mutual benefit	44.74%	30.46%	40.00%	37.94%
	Colaborative attitude	41.45%	27.01%	36.15%	34.43%
	Completion of task	13.82%	42.53%	23.85%	27.63%

E. Key and Critical Issues

		77	139	99	
Q17. What principal issue was resolved in the discussion of method statement?	Time	11.69%	10.79%	5.05%	9.21%
	Cost	22.08%	20.86%	23.23%	21.90%
	Safety	28.57%	30.22%	35.35%	31.43%
	Quality	37.66%	38.13%	36.36%	40.63%

F. Aftermath of Knowledge Transfer

		165	190	100	
Q18. What mainly happened to the method statement after discussion by both parties?	Implemented	13.33%	16.32%	21.00%	16.26%
	Revised	83.64%	68.95%	69.00%	74.29%
	Rejected	3.03%	14.74%	10.00%	9.45%
		164	190	95	
Q19. If this method statement was revised or rejected how was the actual method statement devised?	By the local	18.29%	8.87%	12.63%	12.92%
	By the foreigner	15.24%	11.99%	28.42%	16.48%
	By compromise	61.59%	63.66%	48.42%	59.47%
	By a third party	4.88%	15.48%	10.53%	10.47%
		164	191	100	
Q20. How was the work being carried out with the revised MS?	Normally	29.88%	26.70%	29.00%	28.35%
	Better	70.12%	73.30%	71.00%	71.65%

Note: Main Study Data with Xiaolangdi inside Henan.

Appendix 8: Record of Differences between Total Assessment Inventories Received and the Total Responses

Questions	Answers	With one answer				With more answers				Total 450
		Xiaolangdi (60 cps)	Jiangsu (161cps)	Henan (128cps)	Xinjiang (100cps)	Xiaolangdi	Jiangsu	Henan	Xinjiang	
Q1. Why did you need to determine the method?	This is an open question.									
		60	163	115	101	3	8	29		
Q2. How did you communicate the method statement?	Formal document	47	107	49	42	33.33%	25.00%	48.28%	0	55.81%
	Sketch or note	10	32	65	33	33.33%	37.50%	31.03%	0	31.89%
	Verbal	3	24	1	26	33.33%	37.50%	20.69%	0	12.30%
		52	156	108	100	23	21	53		
Q3. What was the form of method statement mainly based upon?	Copy of handbook	9	35	16	9	26.09%	33.33%	33.96%	0.00%	16.59%
	Previous MS	8	26	17	25	30.43%	33.33%	15.09%	0.00%	18.27%
	Contract document	33	87	57	45	39.13%	28.57%	39.62%	0.00%	53.37%
	Handmade on spot	2	8	18	21	4.35%	4.76%	11.32%	0.00%	11.54%
		78	162	107	100	10	18	64		
Q4. What was the main reason that a method statement was needed for the task?	Complicated task	5	30	4	4	20.00%	22.22%	23.44%	0.00%	9.62%
	Resource allocation	21	59	36	51	10.00%	22.22%	18.75%	0.00%	37.36%
	Guidance of work	9	42	12	17	30.00%	27.78%	32.81%	0.00%	17.90%
	Required by client	43	31	55	28	40.00%	27.78%	25.00%	0.00%	35.12%
		60	165	131	100					
Q5. Which party had the final say in terms of method statemnet?	Local	3	28	6	22	0.00%	0.00%	0.00%	0.00%	12.94%
	Foreign	6	41	4	30	0.00%	0.00%	0.00%	0.00%	17.76%
	Together	51	96	121	48	0.00%	0.00%	0.00%	0.00%	59.21%
		63	166	129	98					
Q6. Which party was mainly involved in the process of discussing method statement?	Local	1	13	40	13	0.00%	0.00%	0.00%	0.00%	14.35%
	Foreign	4	28	16	30	0.00%	0.00%	0.00%	0.00%	16.74%
	Together	58	125	73	55	0.00%	0.00%	0.00%	0.00%	67.61%
B. What is Transferred?										
		59	157	114	101	6	22	30		

Q7. What was the main type of knowledge that needed to flow between foreign and local managers?	Construction technology	10	26	18	31	50.00%	50.00%	50.00%	0.00%	19.72%
	Management knowhow	49	131	96	70	50.00%	50.00%	50.00%	0.00%	80.28%
		57	157	121	99	8	10	13		
Q8. What was the main type of knowledge that actually did flow between foreign and local managers?	Construction technology	12	52	41	31	50.00%	50.00%	46.15%	0.00%	31.11%
	Management knowhow	45	105	80	68	50.00%	50.00%	53.85%	0.00%	68.66%
		58	151	129	102	4	38	6		
Q9. What was the main type of knowledge that needed to flow between foreign and local managers?	Explicit knowledge	15	51	88	52	50.00%	50.00%	50.00%	0.00%	46.82%
	Tacit Knowledge	43	100	41	50	50.00%	50.00%	50.00%	0.00%	53.18%
		57	156	118	95	4	4	19		
Q10. What was the main type of knowledge that actually did flow between foreign and local managers?	Explicit knowledge	16	75	61	44	50.00%	50.00%	47.37%	0.00%	45.77%
	Tacit Knowledge	41	81	57	51	50.00%	50.00%	52.63%	0.00%	53.99%

C. How was knowledge transferred?

		51	151	114	98	35	28	36	2	
Q11. What was the main channel of explicit knowledge transfer?	Conferences	21	45	23	30	20.00%	35.71%	5.56%	50.00%	29.95%
	Meetings	18	46	61	13	20.00%	25.00%	8.33%	0.00%	33.33%
	Seminars	7	42	16	49	34.29%	25.00%	47.22%	50.00%	27.54%
	Training sessions	5	18	14	6	25.71%	14.29%	38.89%	0.00%	10.39%
		49	140	117	99	10	45	28		
Q12. What was the main channel of tacit knowledge transfer?	Job training	16	25	47	12	60.00%	11.11%	32.14%	0.00%	24.44%
	Telephonic communication	8	31	22	22	40.00%	42.22%	7.14%	0.00%	20.49%
	Social occasions	13	55	24	53	0.00%	31.11%	39.29%	0.00%	35.80%
	Chance meeting	12	29	24	12	0.00%	15.56%	21.43%	0.00%	18.77%
		61	164	130	99					
Q13. What was the principal pattern of knowledge transfer?	Foreign to local	7	47	70	28	0.00%	0.00%	0.00%	0.00%	33.48%
	Local to foreign	2	24	10	33	0.00%	0.00%	0.00%	0.00%	15.20%
	Two way process	52	93	50	38	0.00%	0.00%	0.00%	0.00%	51.32%

D. Success of Knowledge Transfer

		56	151	120	99	14	28	22	4	
Q14. What was the main influencing	Culture	15	15	16	32	42.86%	32.14%	13.64%	25.00%	18.31%

factor of knowledge transfer?	Language	12	46	91	25	21.43%	42.86%	36.36%	25.00%	40.85%
	Common objective	16	55	6	14	14.29%	10.71%	9.09%	25.00%	21.36%
	Social values	13	35	7	28	21.43%	14.29%	40.91%	25.00%	19.48%
		55	160	115	96	14	12	30	3	
Q15. What was the primary factor	Mutual respect	19	29	41	34	35.71%	41.67%	30.00%	33.33%	28.87%
in achieving successful	Close co-operation	34	97	54	47	42.86%	41.67%	43.33%	33.33%	54.46%
knowledge transfer?	Appropriate coordination	2	34	20	15	21.43%	16.67%	26.67%	33.33%	16.67%
		55	152	119	130	15	11	25		
Q16. What was the principal	Mutual benefit	24	68	29	52	46.67%	45.45%	40.00%	0.00%	37.94%
motivator in achieving successful	Colaborative attitude	18	63	29	47	46.67%	45.45%	32.00%	0.00%	34.43%
knowledge transfer?	Completion of task	13	21	61	31	6.67%	9.09%	28.00%	0.00%	27.63%

E. Key and Critical Issues

		35	77	104	99	47	95	61		
Q17. What principal issue was	Time	12	9	3	5	23.40%	24.21%	19.67%	0.00%	9.21%
resolved in the discussion of	Cost	1	17	18	23	27.66%	34.74%	36.07%	0.00%	21.90%
method statement?	Safety	4	22	38	35	14.89%	9.47%	3.28%	0.00%	31.43%
	Quality	18	29	45	36	34.04%	31.58%	40.98%	0.00%	40.63%

F. Aftermath of Knowledge Transfer

		61	165	129	100					
Q18. What mainly happened to the	Implemented	9	22	22	21	0.00%	0.00%	0.00%	0.00%	16.26%
method statement after	Revised	52	138	79	69	0.00%	0.00%	0.00%	0.00%	74.29%
discussion by both parties?	Rejected	0	5	28	10	0.00%	0.00%	0.00%	0.00%	9.45%
		61	164	129	95					
Q19. If this method statement was	By the local	3	30	14	12	0.00%	0	0	0	12.92%
revised or rejected how was the	By the foreigner	4	25	19	27	0.00%	0	0	0	16.48%
actual method statement devised?	By compromise	50	101	71	46	0.00%	0	0	0	59.47%
	By a third party	4	8	25	10	0.00%	0	0	0	10.47%
		62	164	129	100					
Q20. How was the work being carried	Normally	6	49	45	29		0	0	0	28.35%
out with the revised MS?	Better	56	115	84	71		0	0	0	71.65%

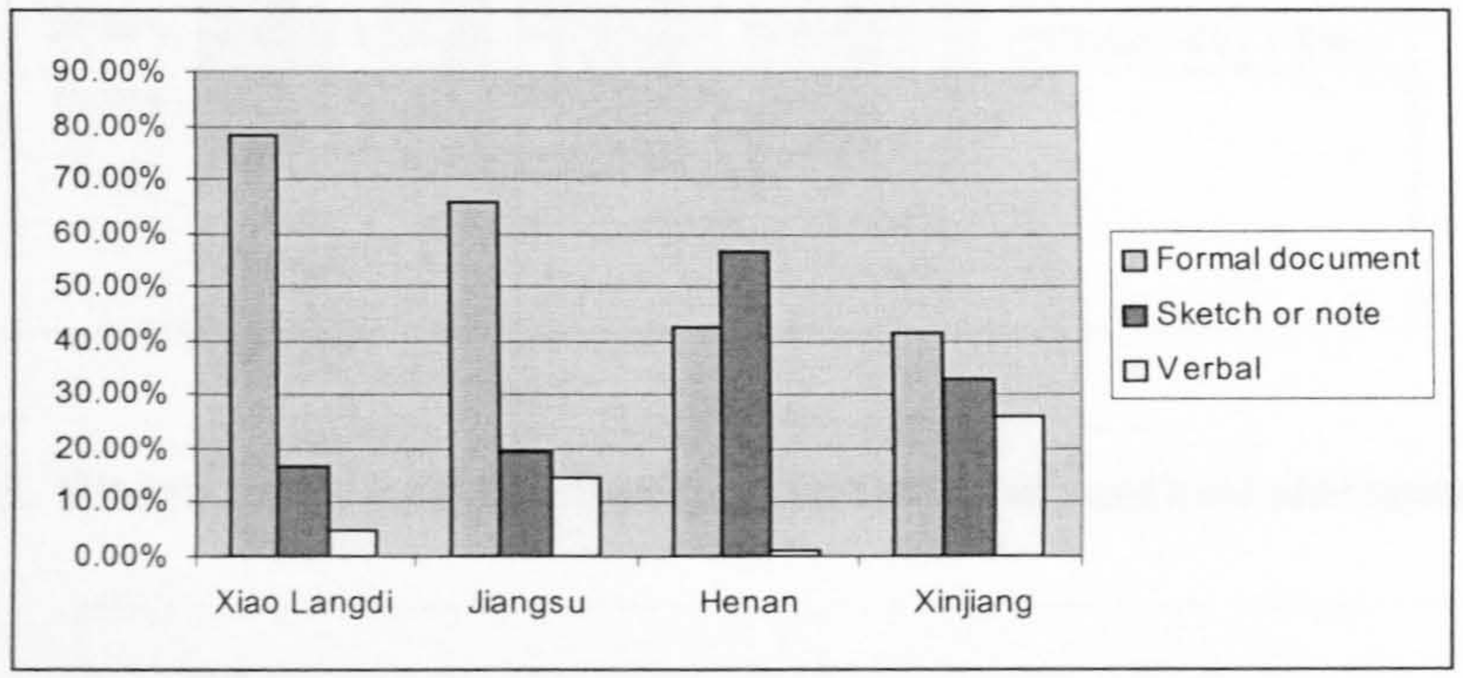
Appendix 9: Record of Difference between Total Assessment Inventories Received and the Total Responses (bar charts)

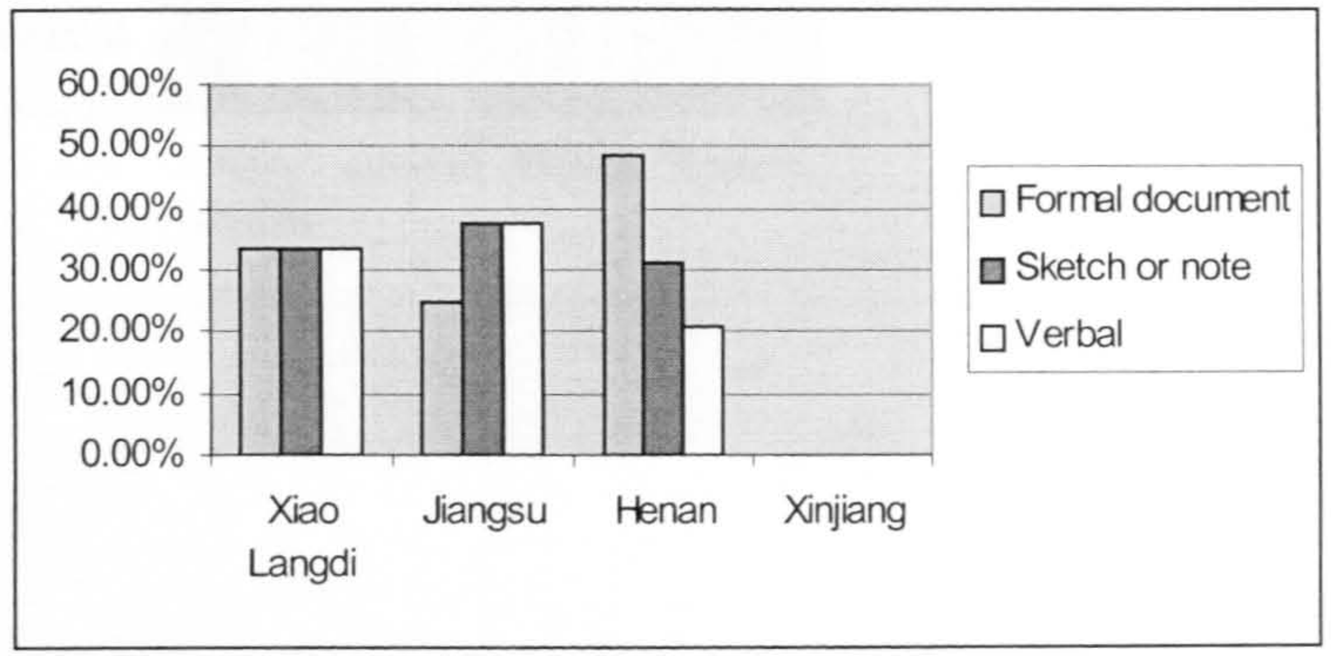
With one answer

With more answers

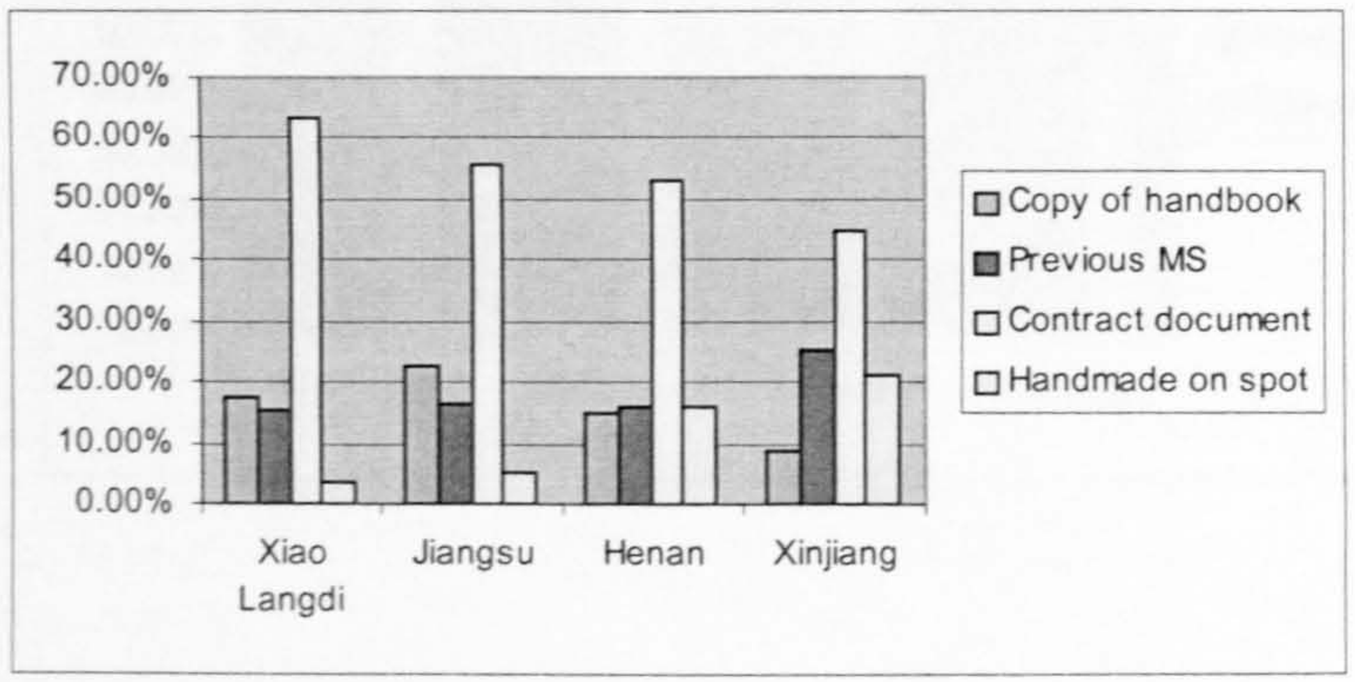
1.Why did you need to determine the method?

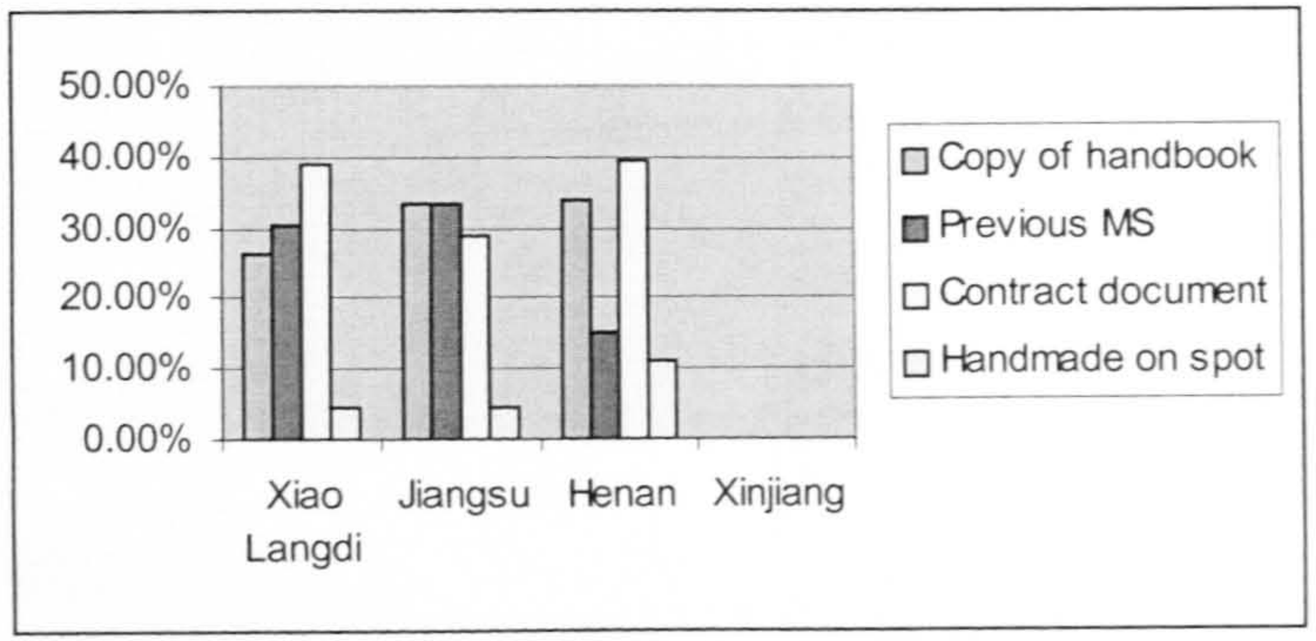
2. How did you communicate the method statement?
(from now on I will call this the 'method statement')



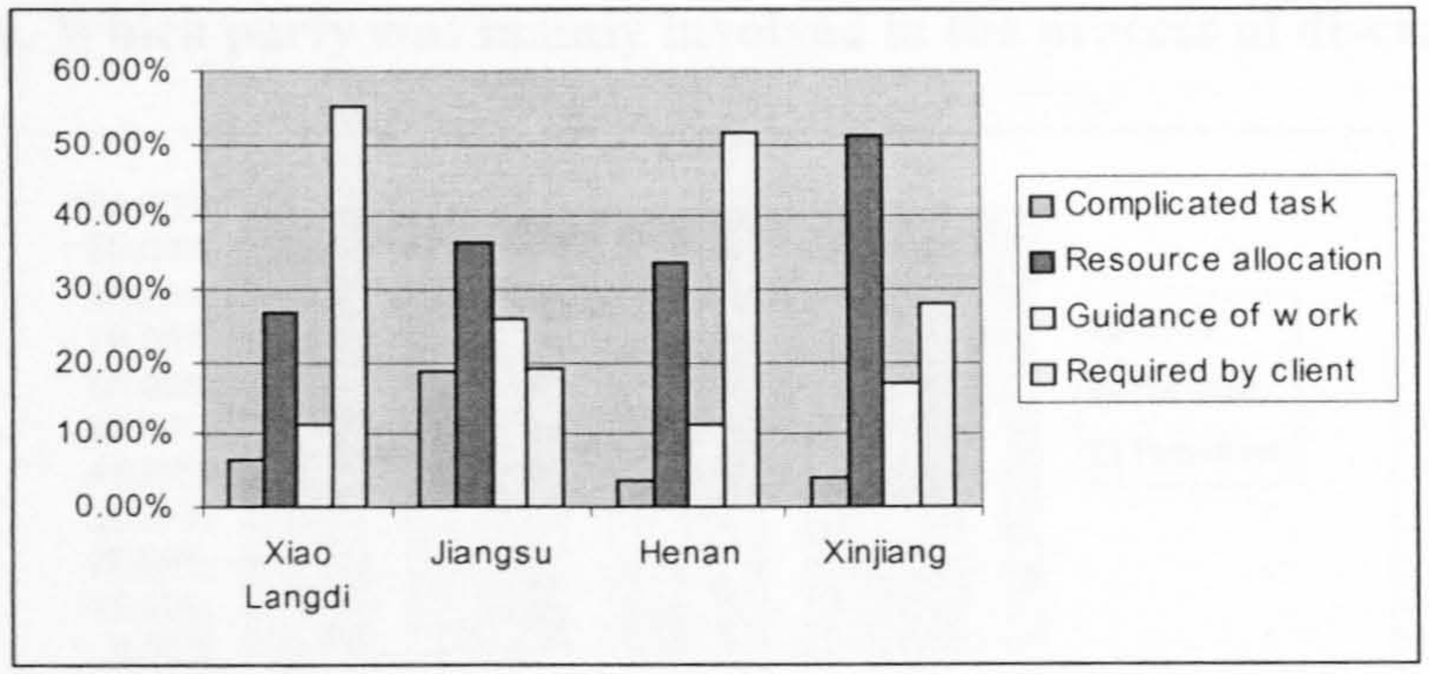


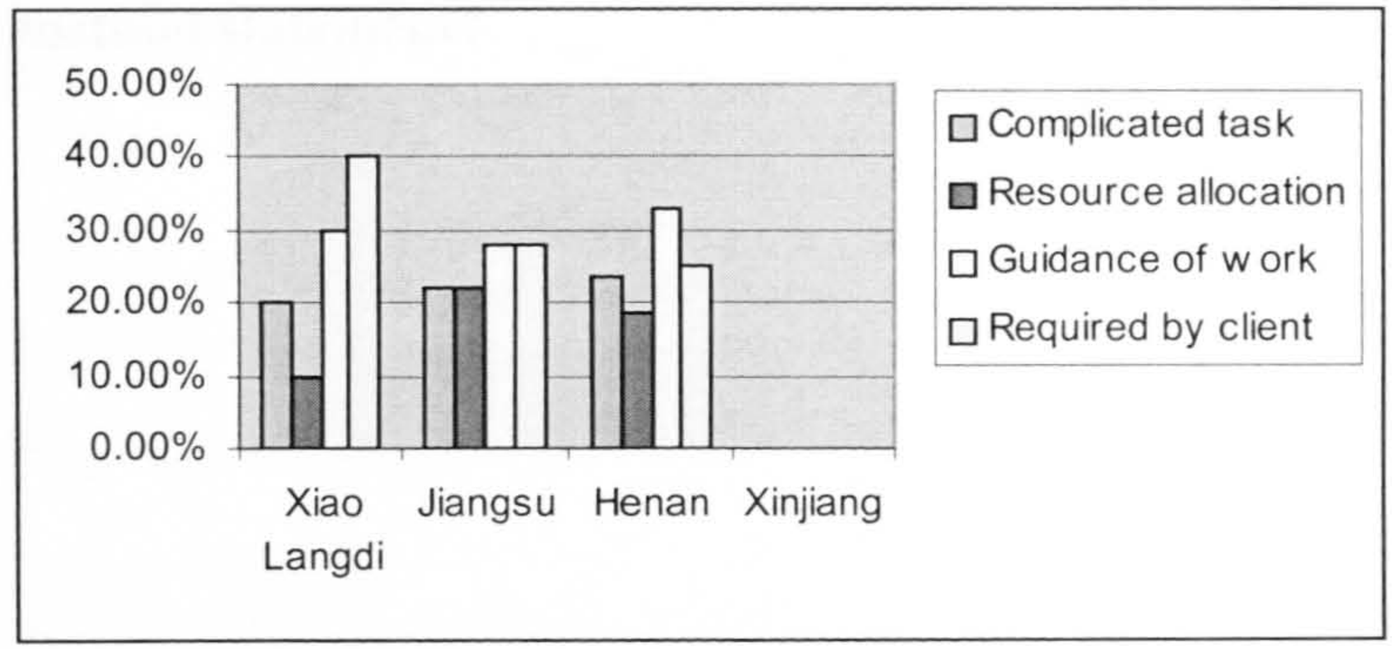
3. What was the form of method statement mainly based upon?



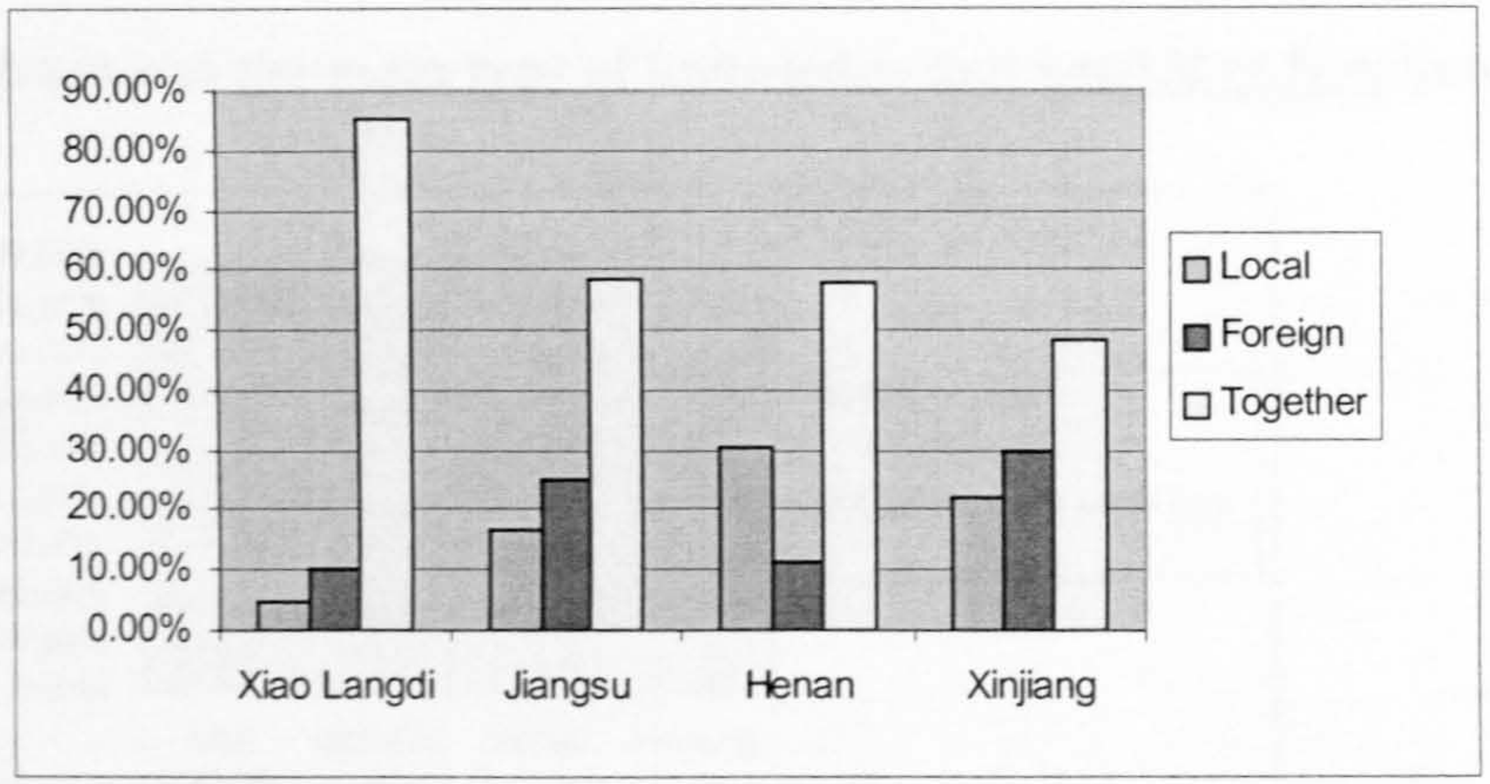


4. What was the main reason that a method statement was needed for the task?

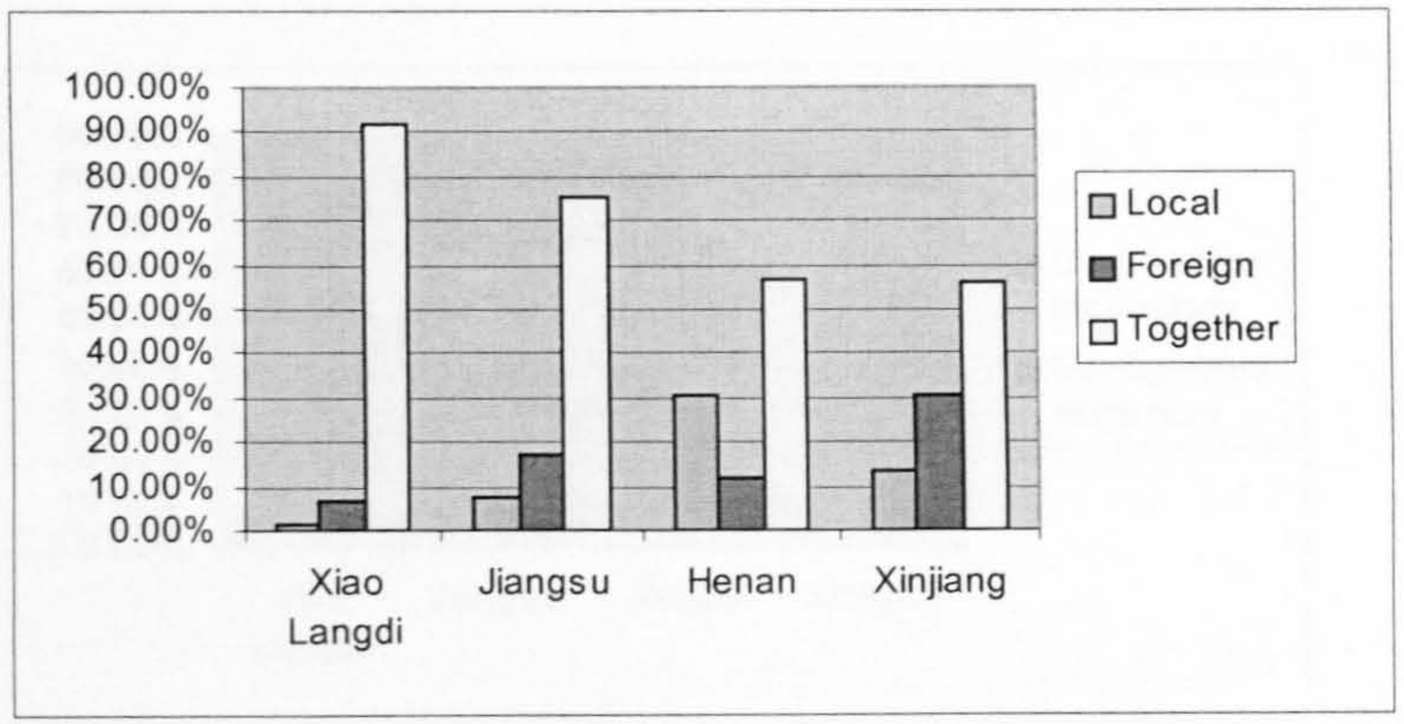




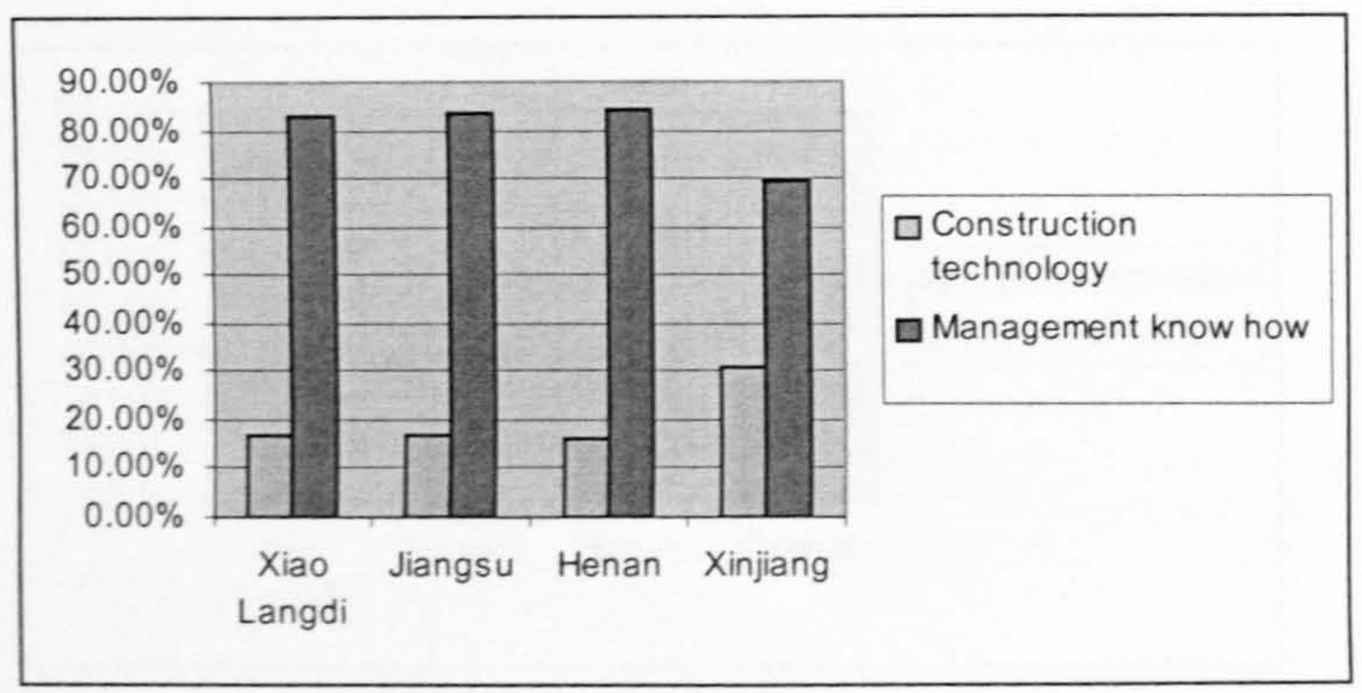
5. Which party had the final say in terms of method statement?

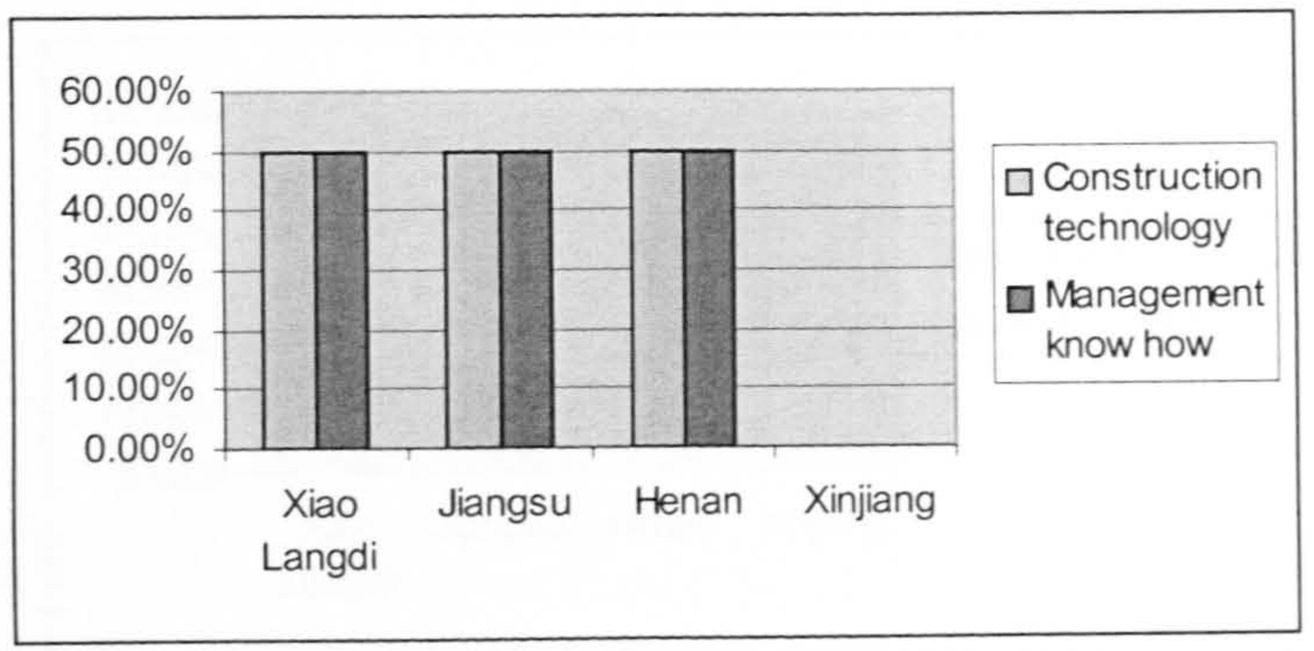


6. Which party was mainly involved in the process of discussing method statement?

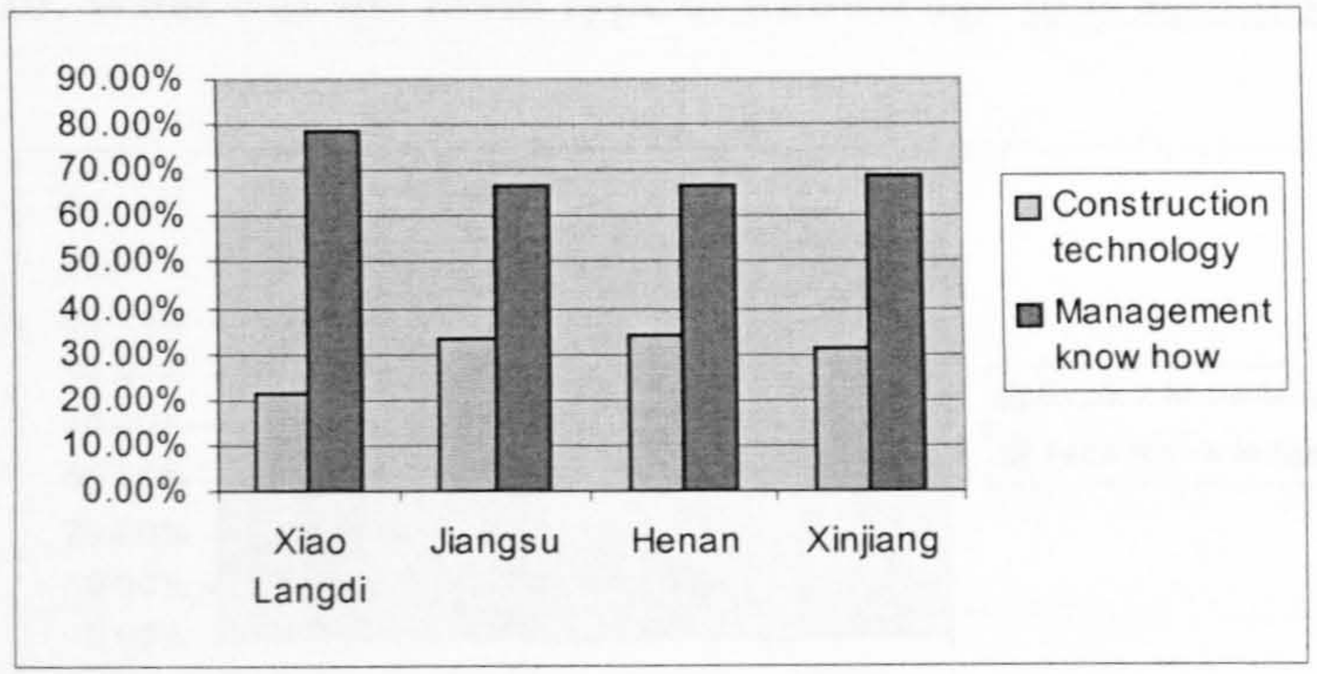


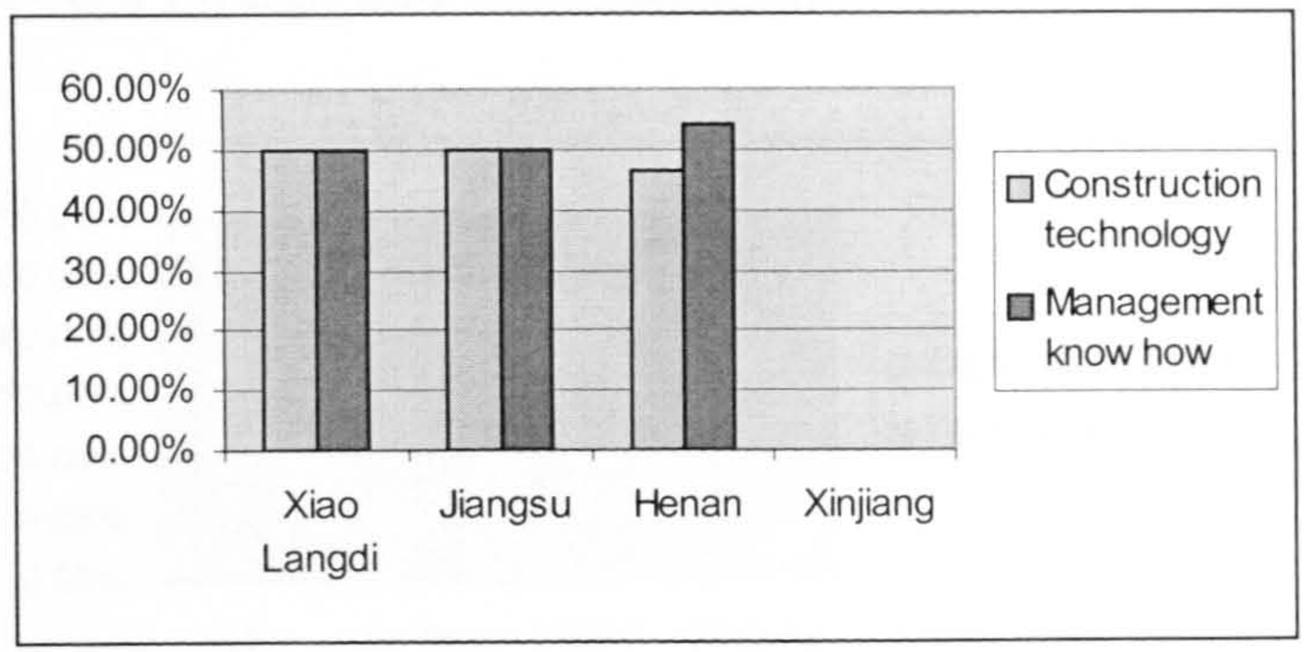
7. What was the main type of knowledge <u>that needed to flow</u> between foreign and local managers?



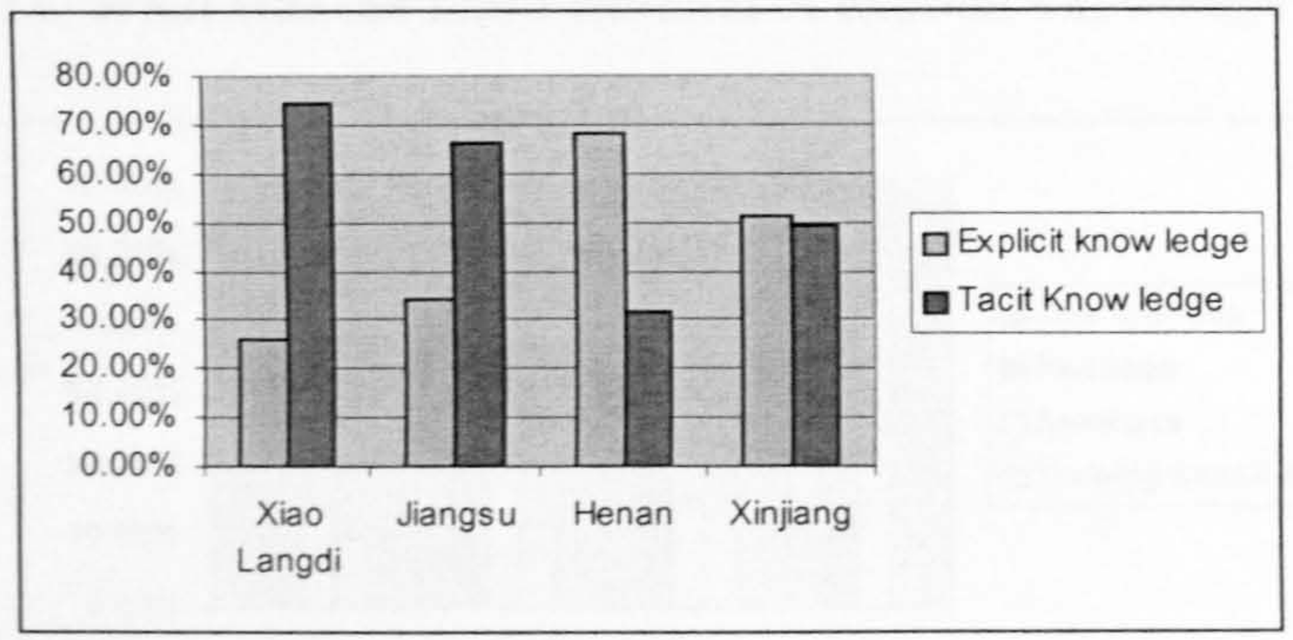


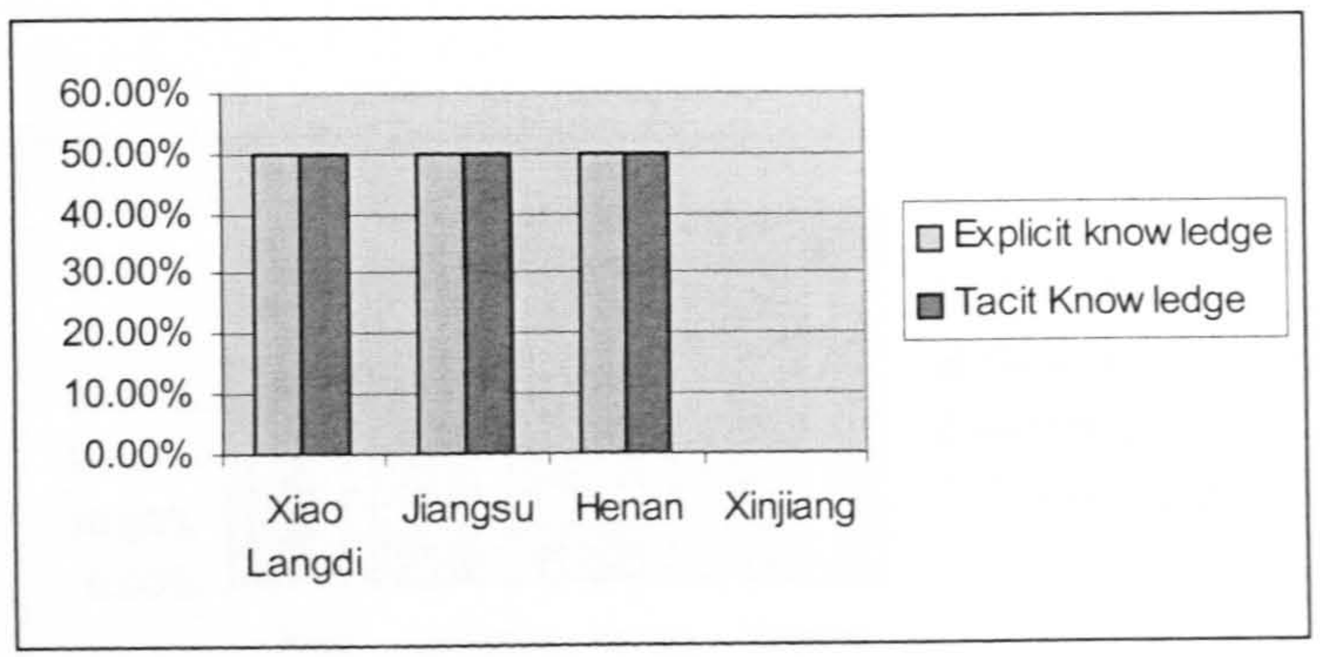
8. What was the main type of knowledge <u>that actually did flow</u> between foreign and local managers?



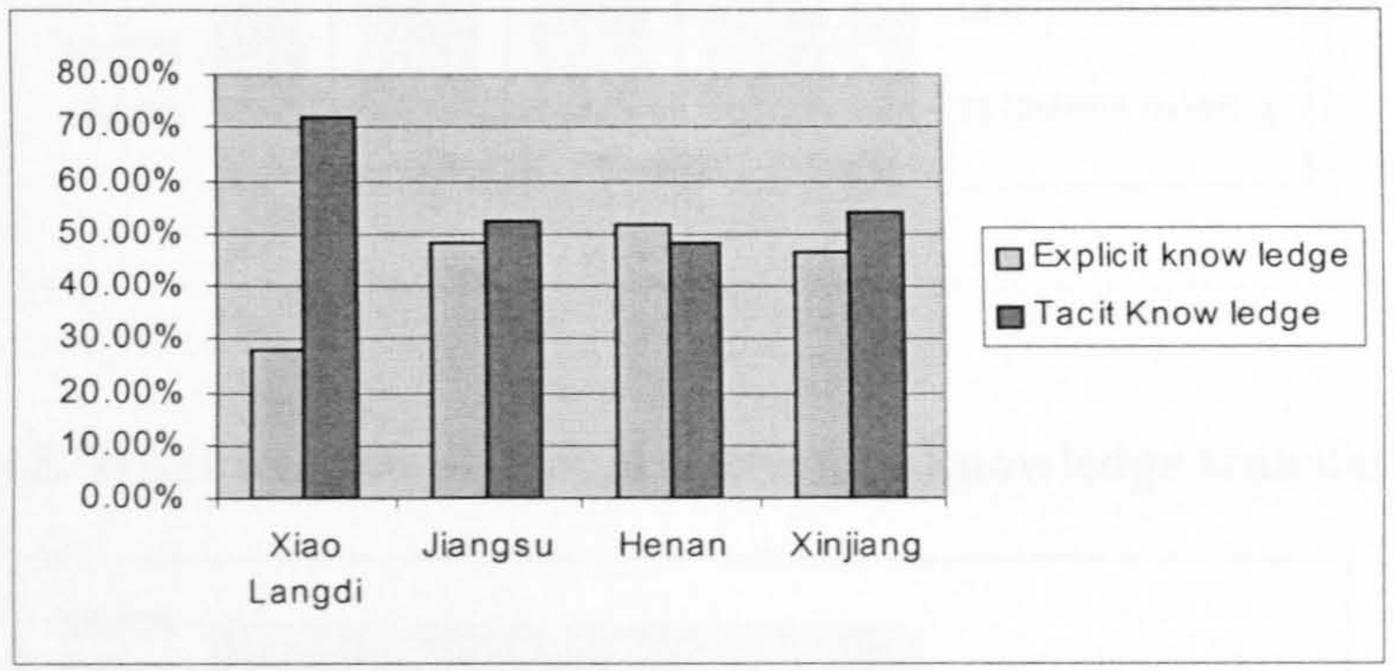


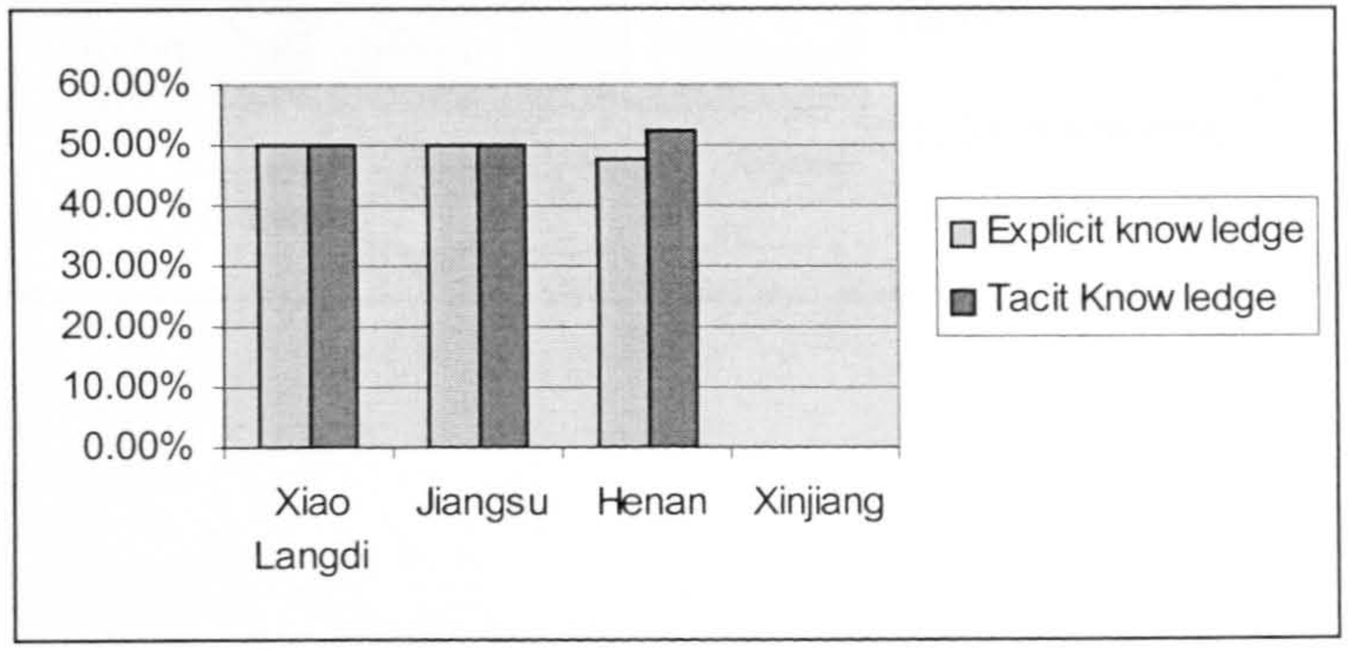
9. What was the main type of knowledge <u>that needed to flow</u> between foreign and local managers?



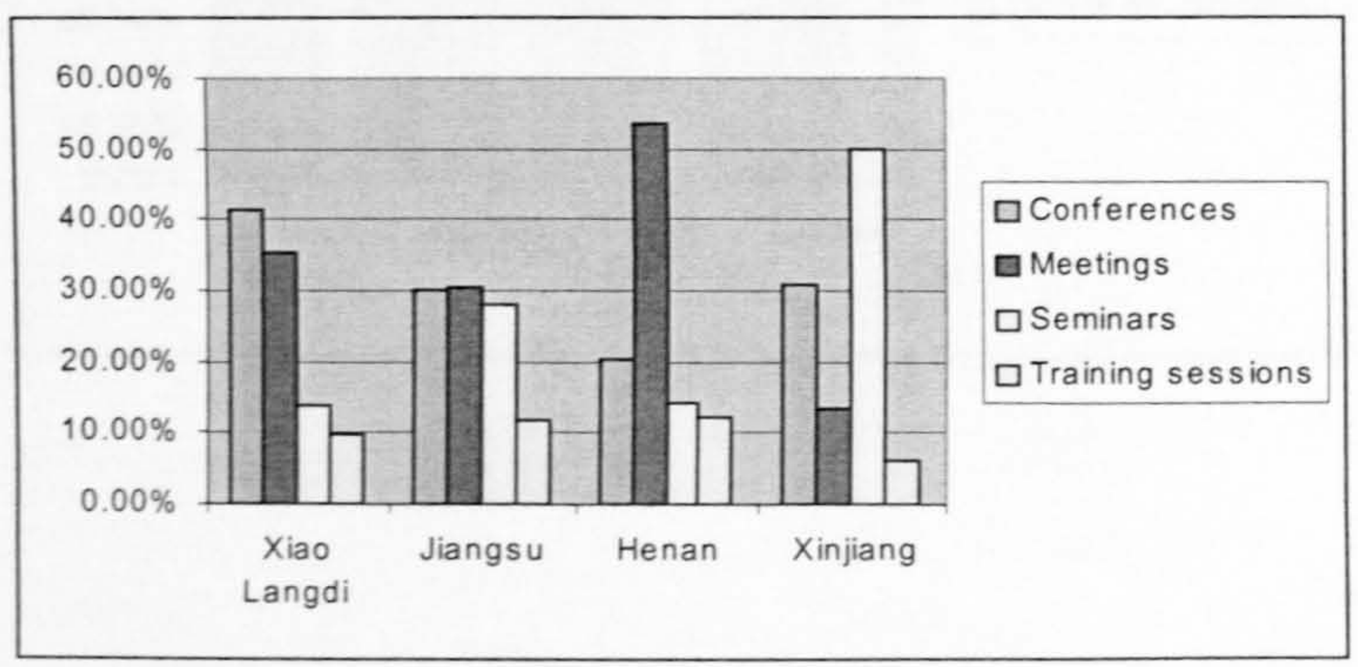


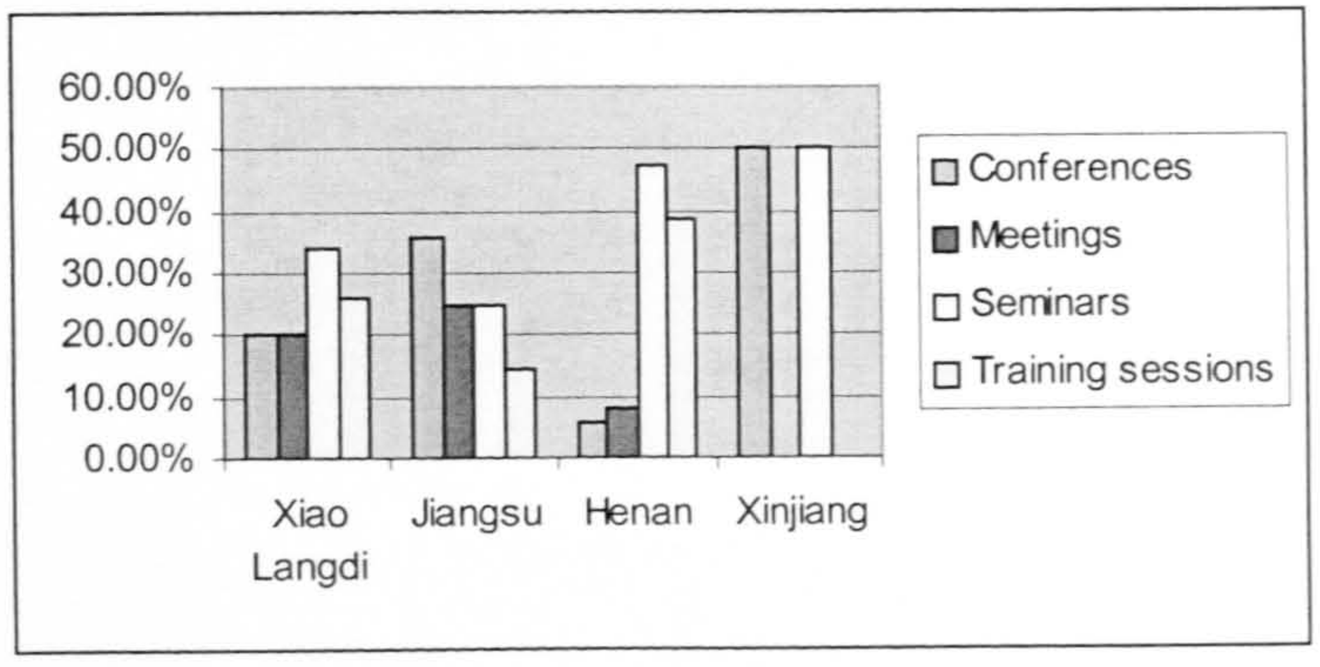
10. What was the main type of knowledge <u>that actually did flow</u> between foreign and local managers?



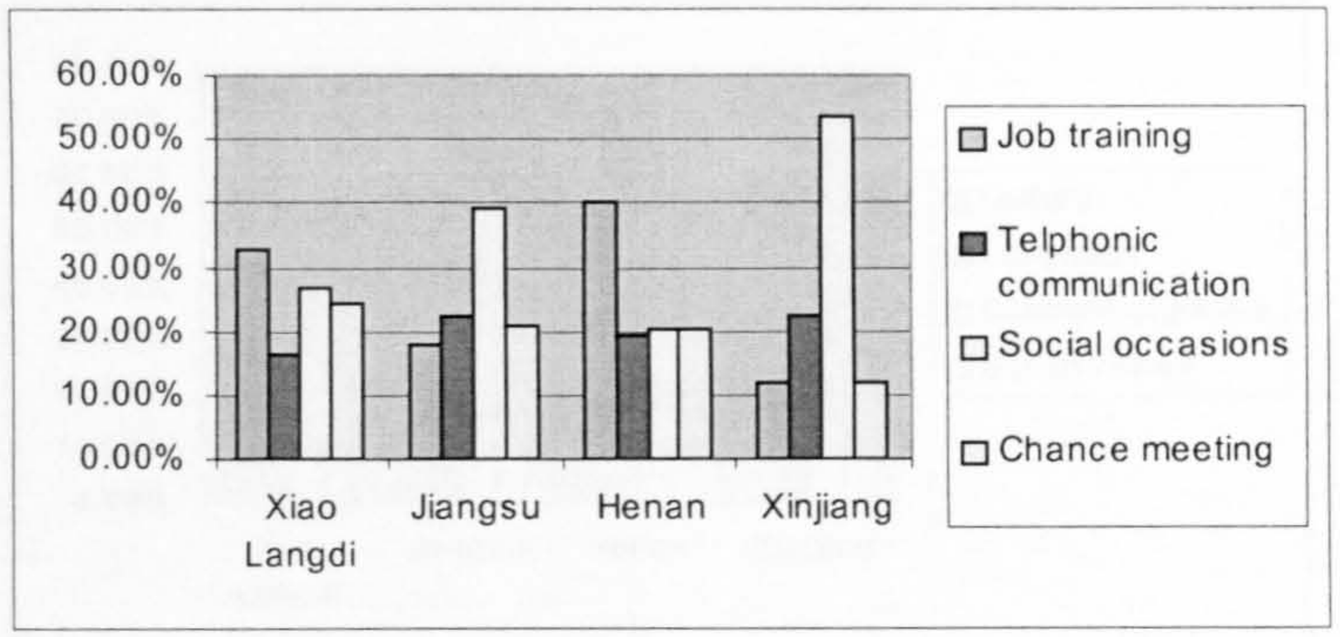


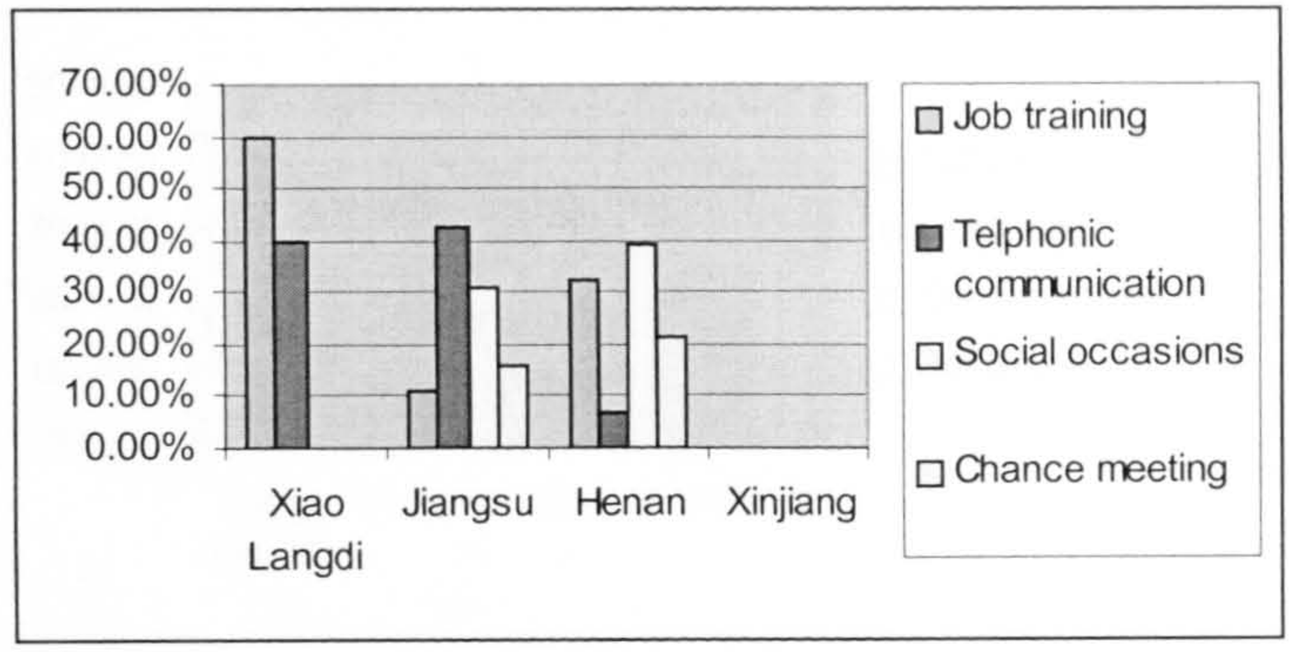
11. What was the main channel of explicit knowledge transfer?



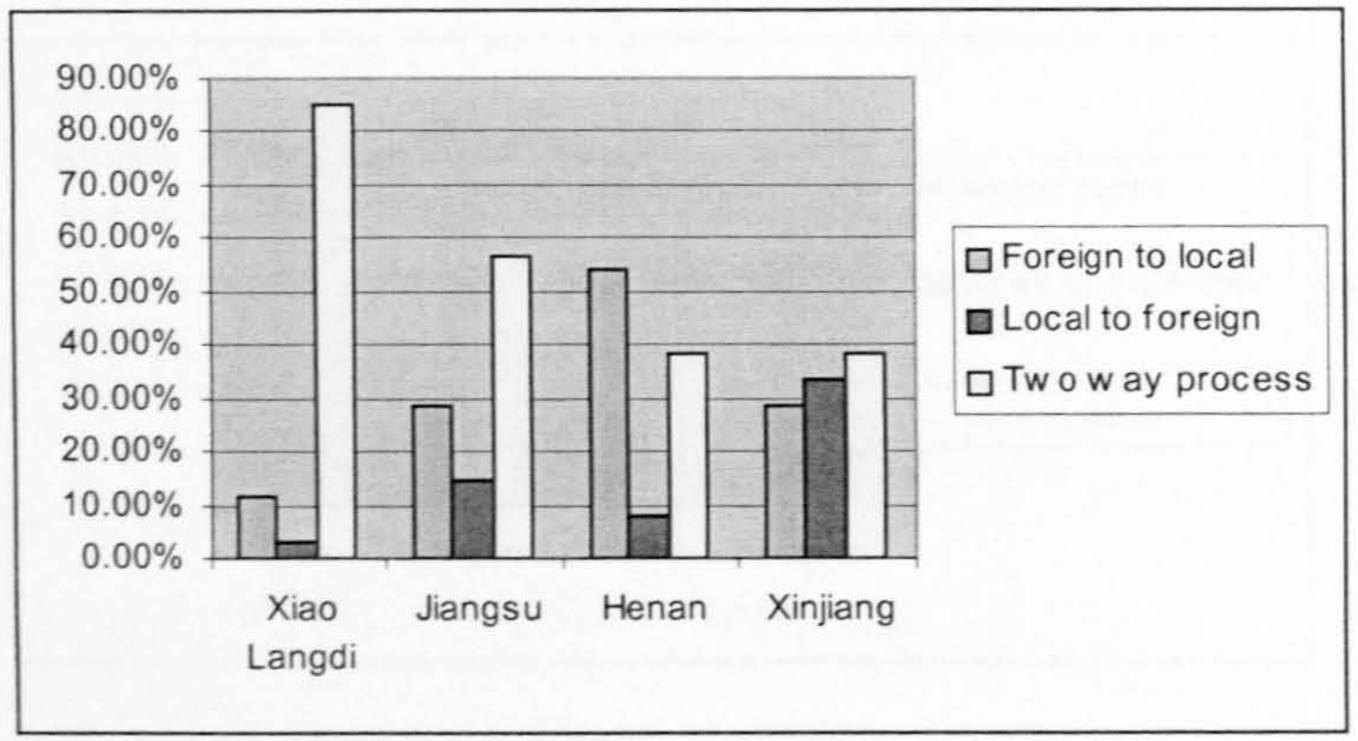


12. What was the main channel of tacit knowledge transfer?

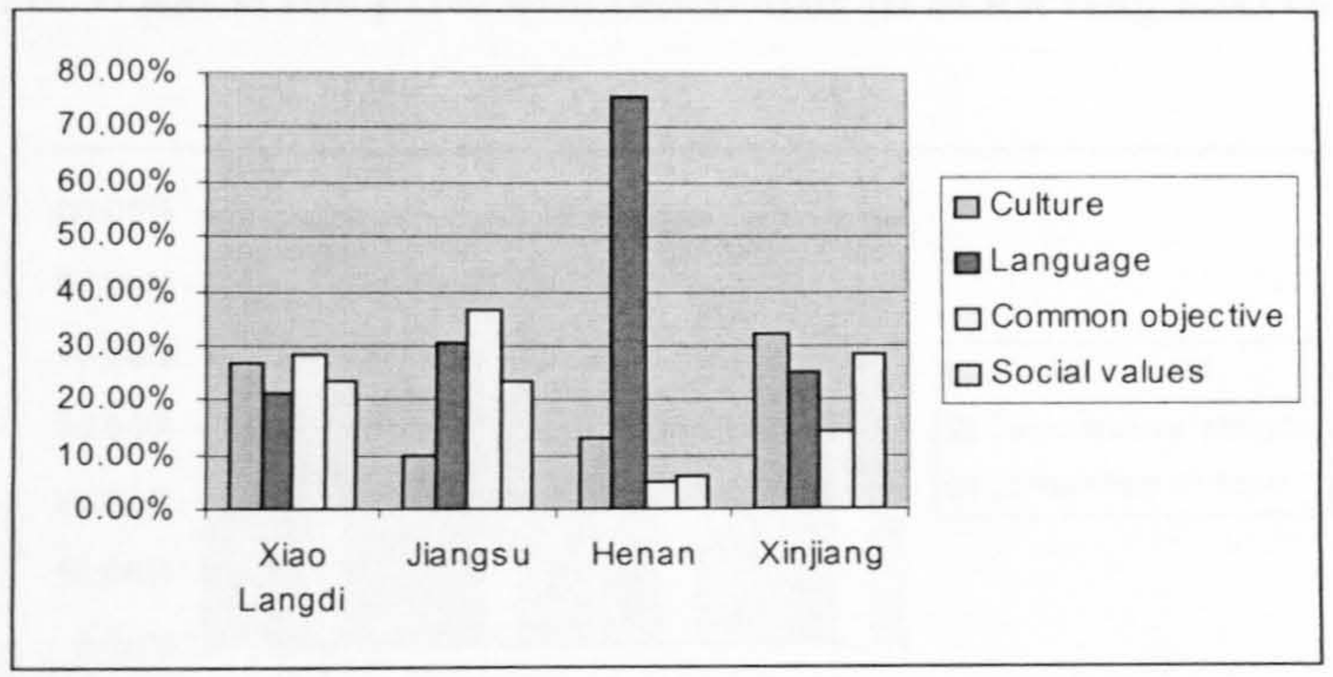


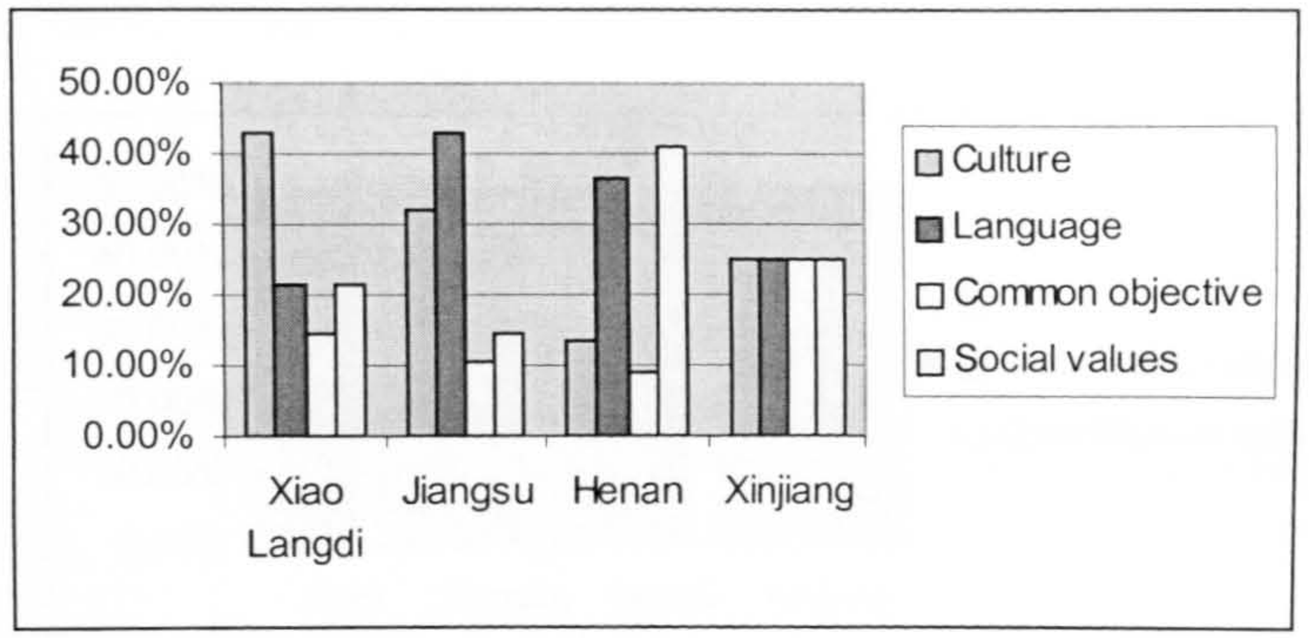


13. What was the principal pattern of knowledge transfer?

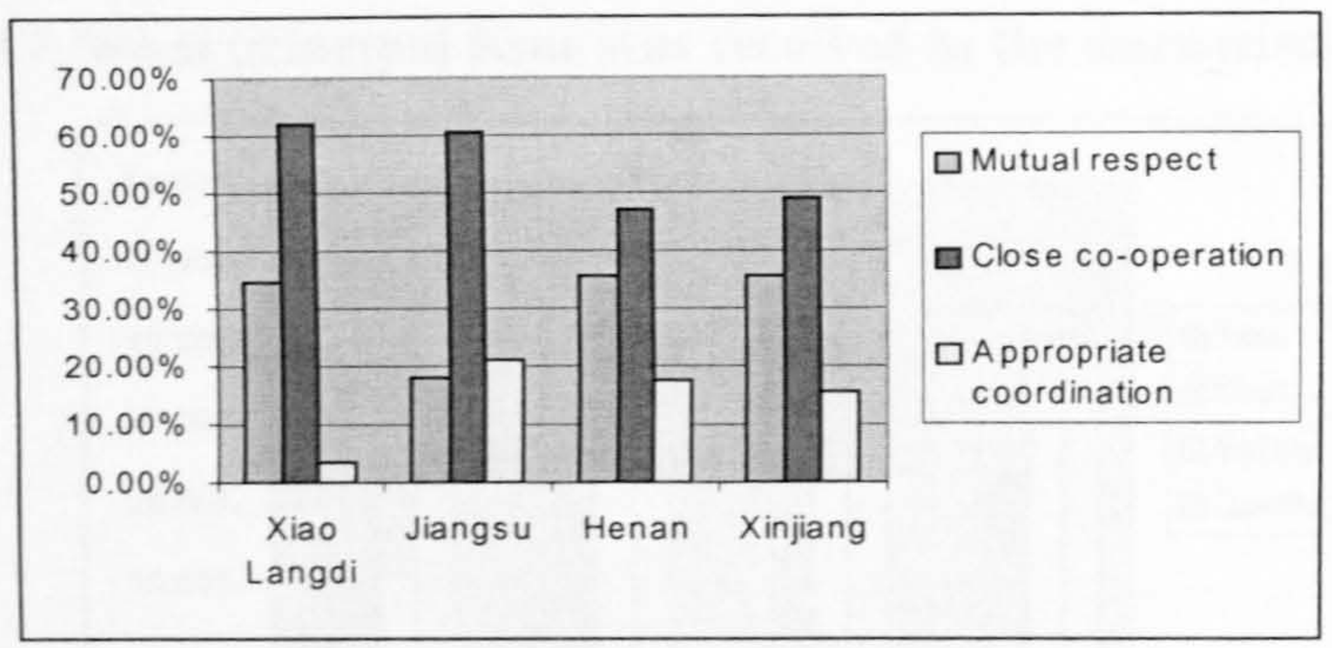


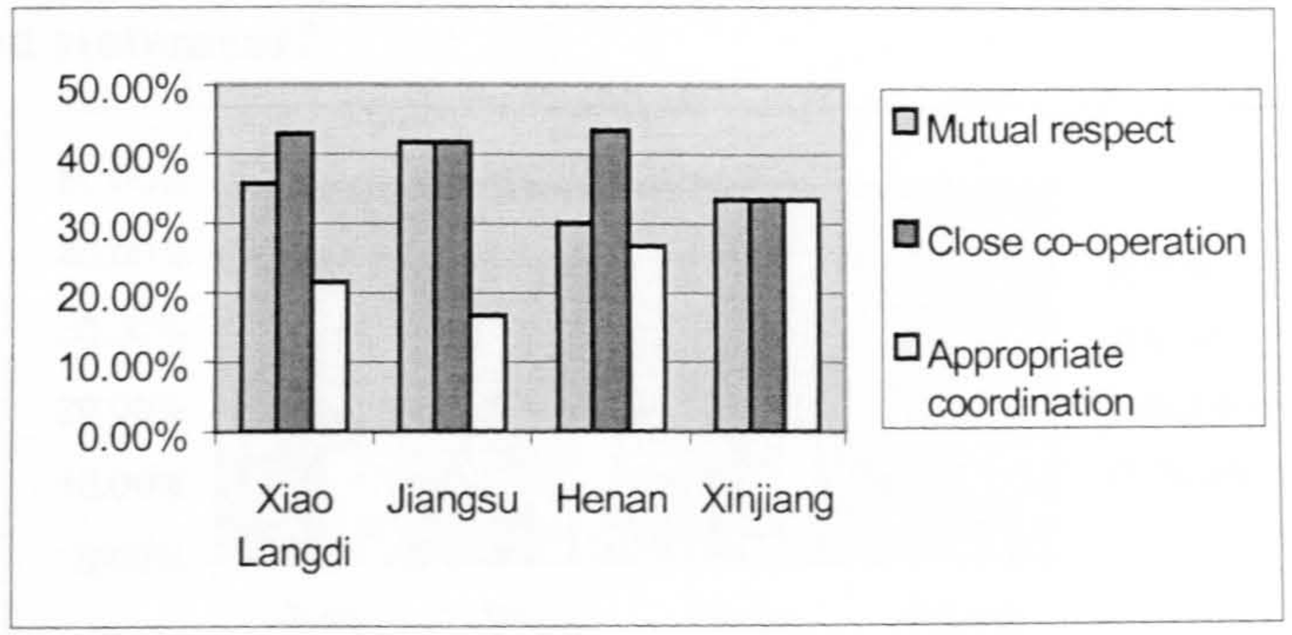
14. What is the main influencing factor of knowledge transfer?



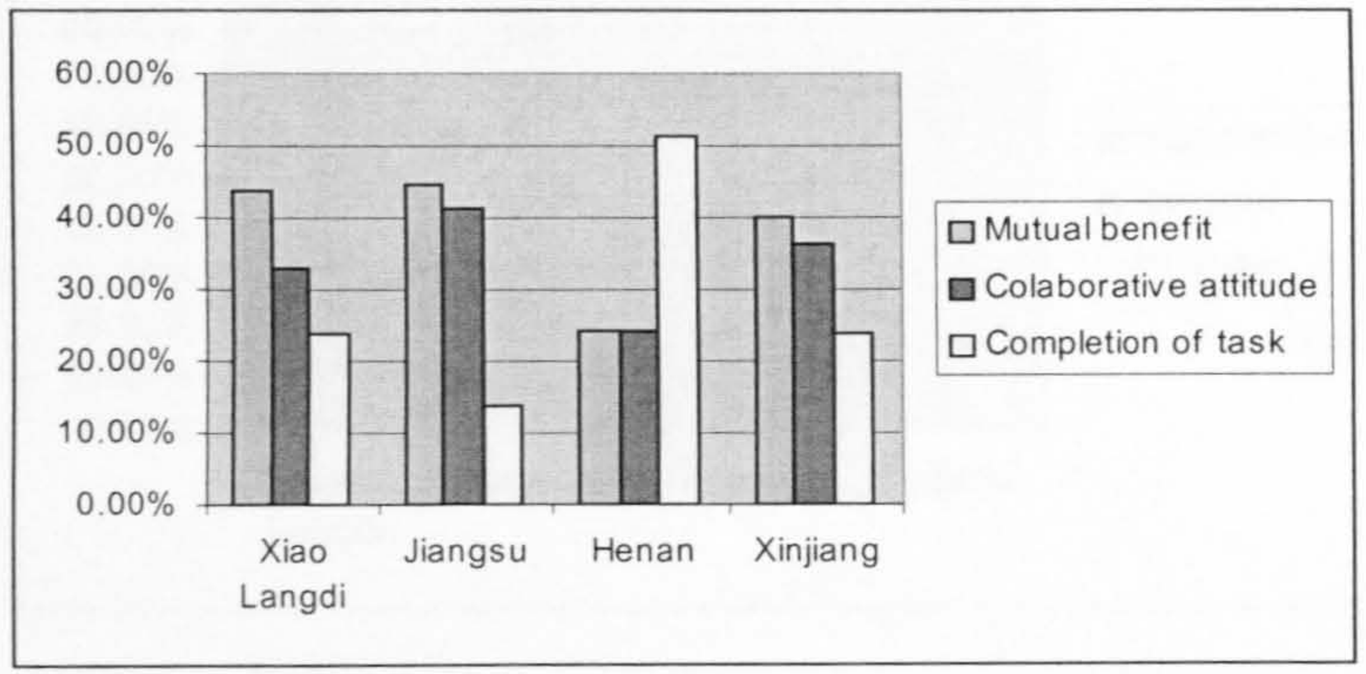


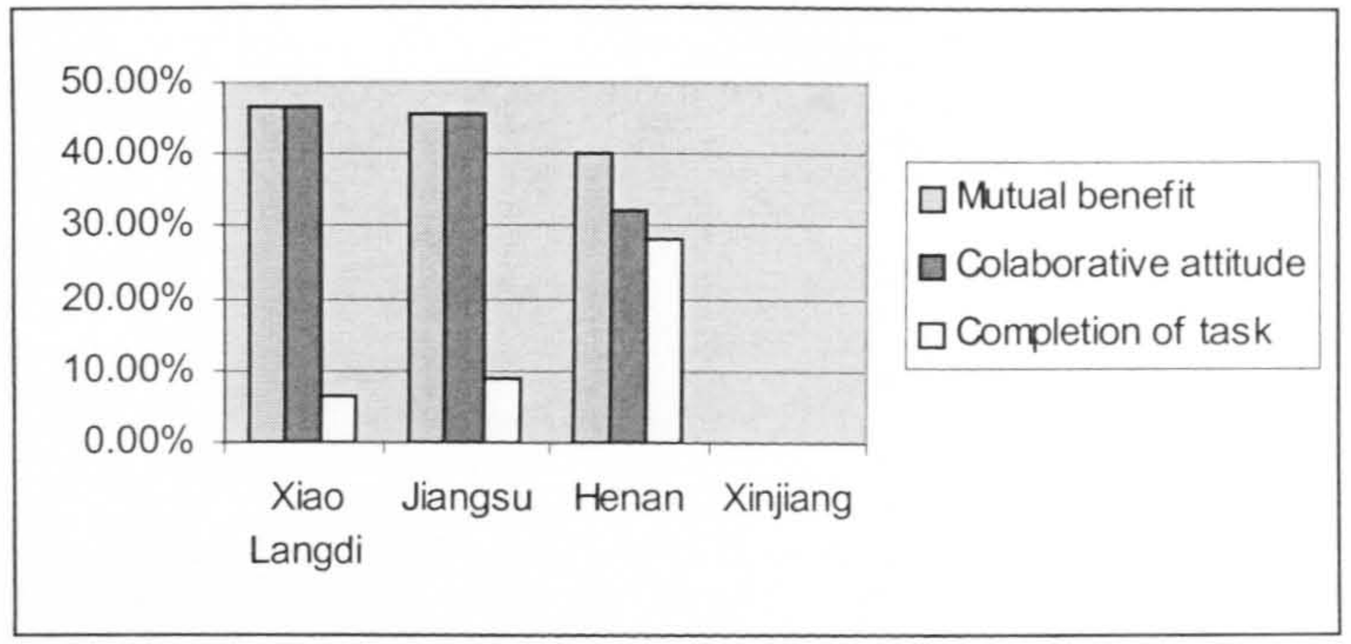
15. What is the primary factor in achieving successful knowledge transfer?



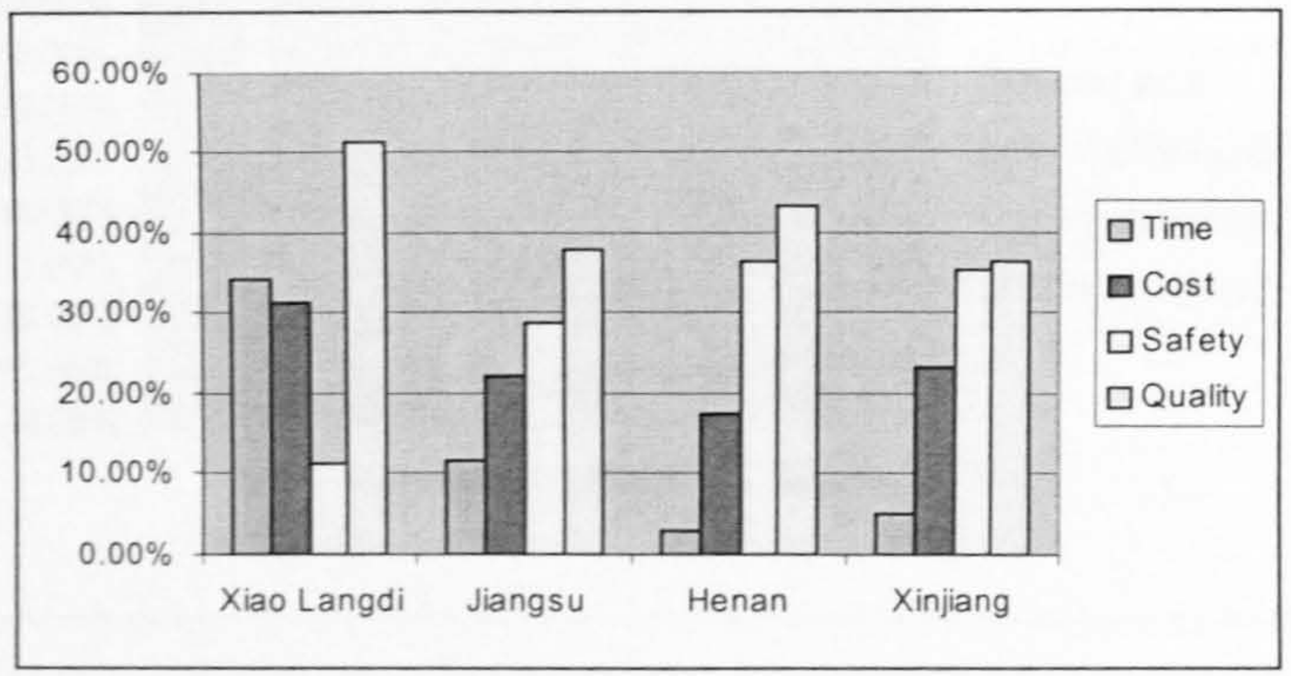


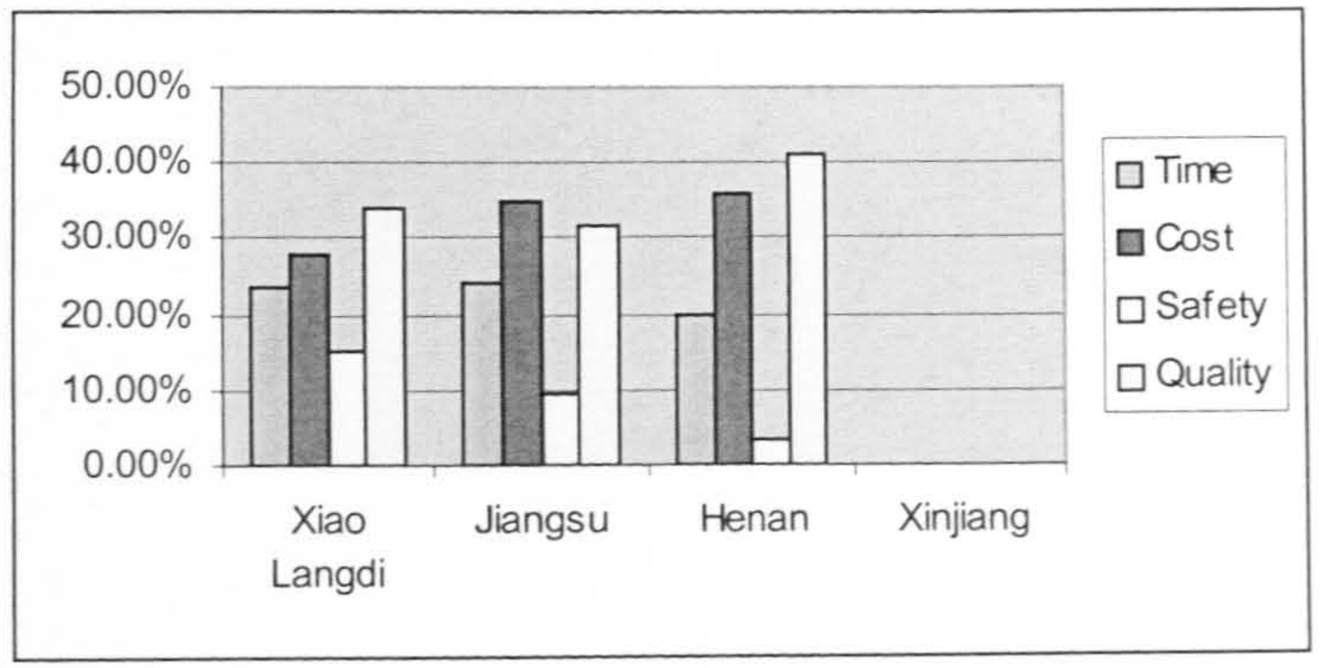
16. What is the principal motivator in achieving successful knowledge transfer?



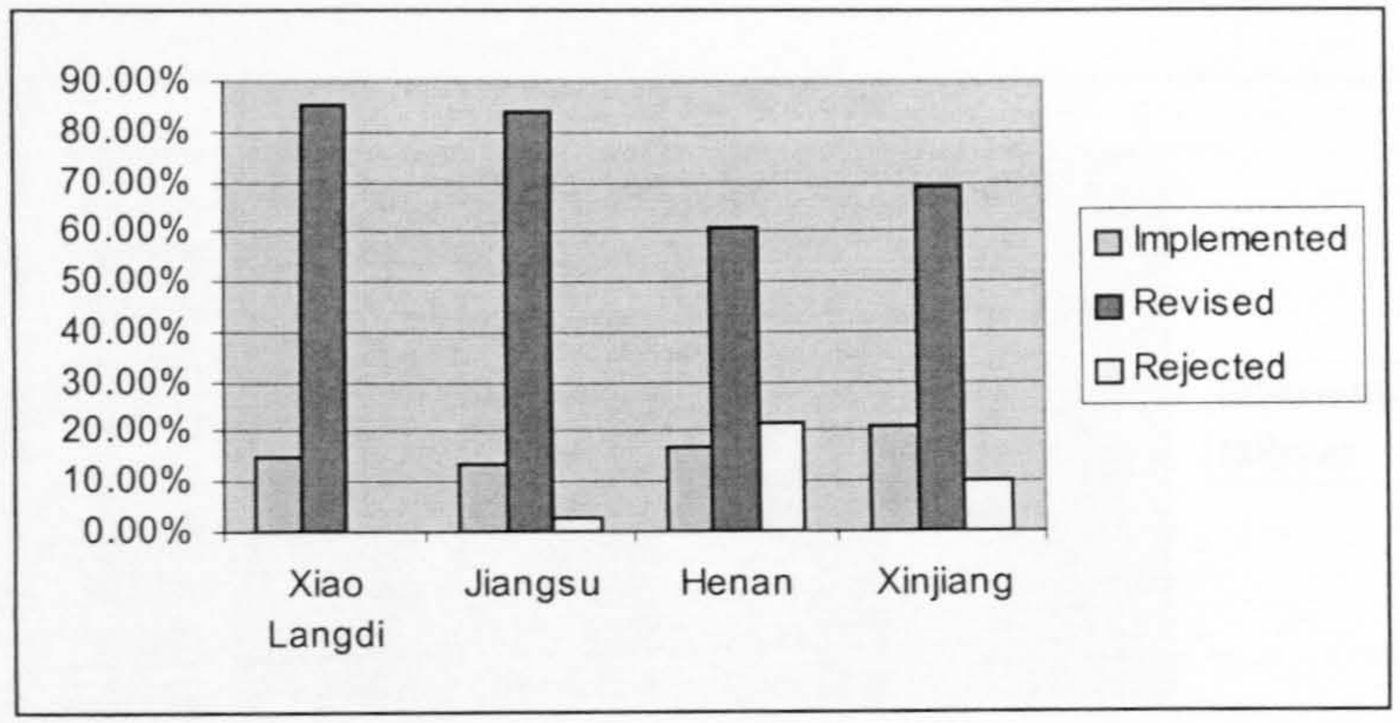


17. What principal issue was resolved in the discussion of method statement?

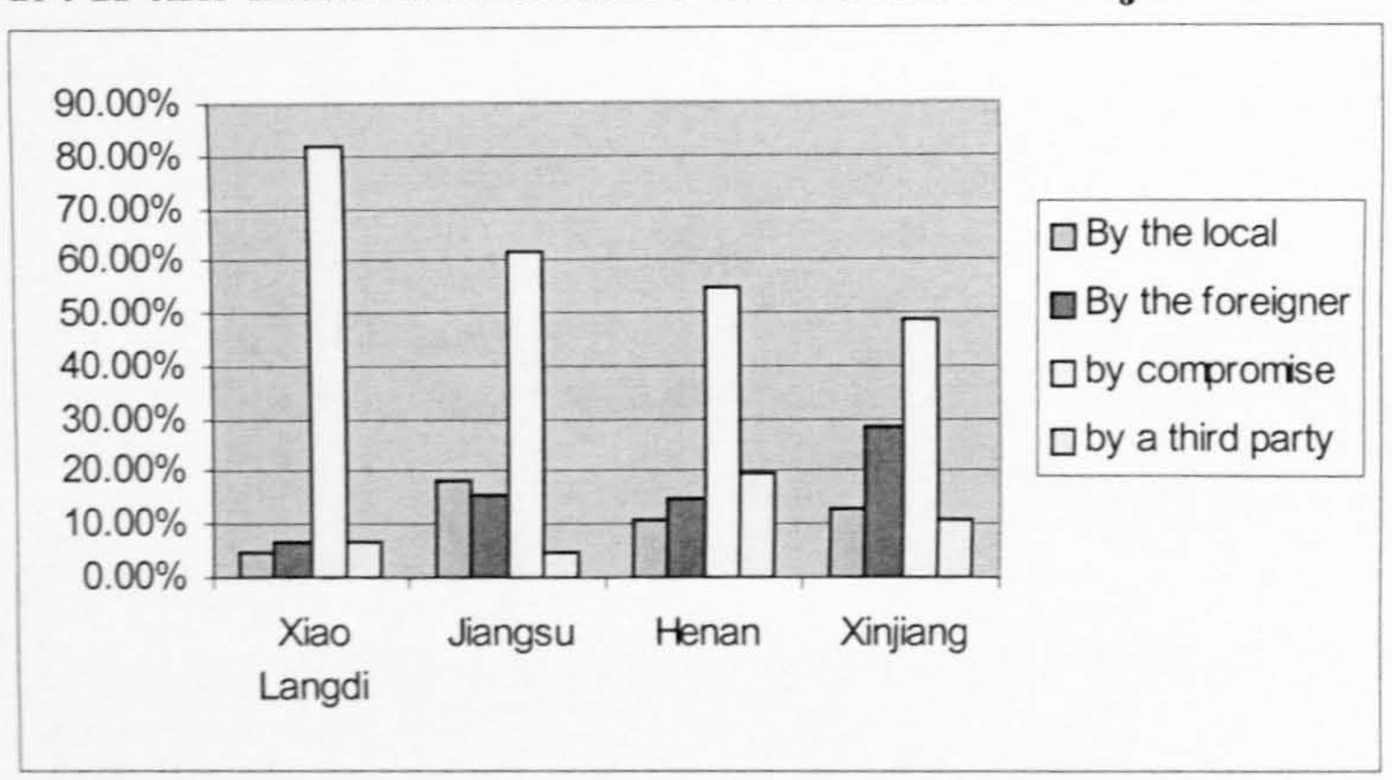




18. What mainly happened to the method statement after the discussion by both parties?



19. If this method statement was revised or rejected how was the actual method statement devised?



20. How was the work being carried out with the revised method statement?